

O. H. LOYNES AND A. F. ROSE.
 REPEATER CORD CIRCUITS.
 APPLICATION FILED SEPT. 23, 1919.

1,391,552.

Patented Sept. 20, 1921.

2 SHEETS—SHEET 1.

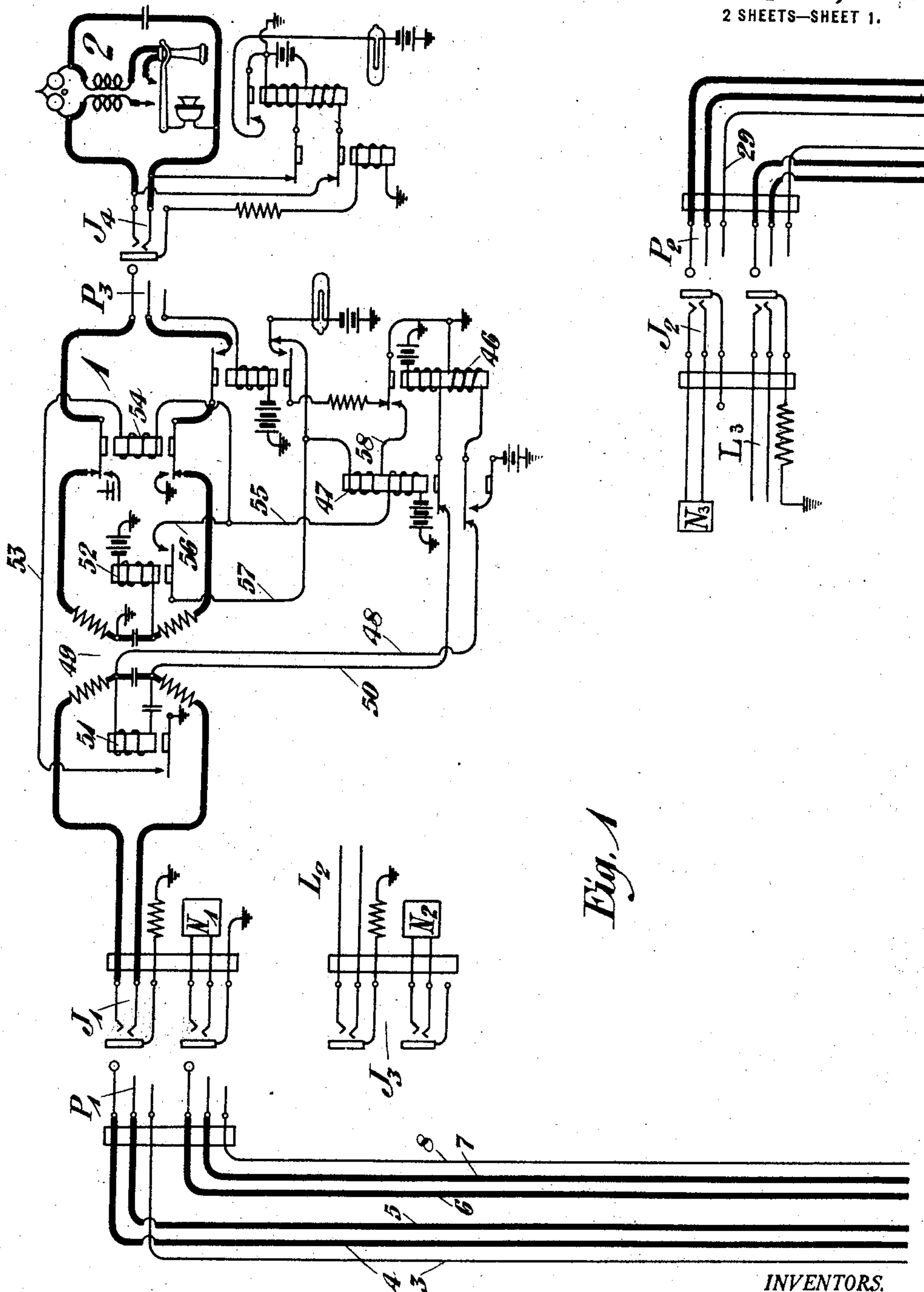


Fig. 1

INVENTORS.
 O. H. Loynes and A. F. Rose
 BY *C. C. Rose*
 ATTORNEY.

O. H. LOYNES AND A. F. ROSE.
 REPEATER CORD CIRCUITS.
 APPLICATION FILED SEPT. 23, 1919.

1,391,552.

Patented Sept. 20, 1921.

2 SHEETS—SHEET 2.

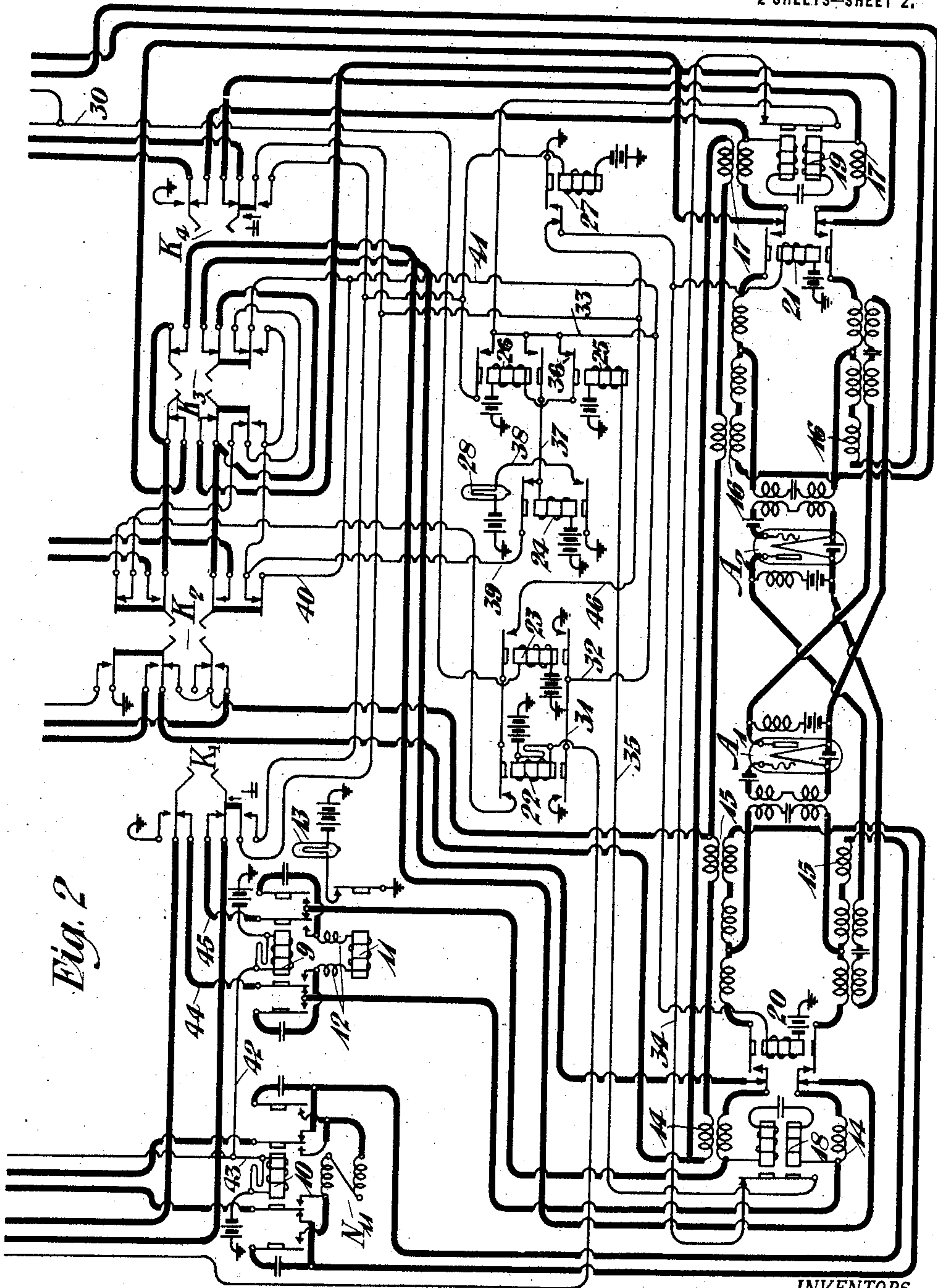


Fig. 2

INVENTORS.
 O. H. Loynes and A. F. Rose
 BY *C. Rose*
 ATTORNEY.

UNITED STATES PATENT OFFICE.

OWEN H. LOYNES, OF WOODRIDGE, NEW JERSEY, AND ARTHUR F. ROSE, OF NEW BRIGHTON, NEW YORK, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

REPEATER CORD-CIRCUITS.

1,391,552.

Specification of Letters Patent. Patented Sept. 20, 1921.

Application filed September 23, 1919. Serial No. 325,761.

To all whom it may concern:

Be it known that we, OWEN H. LOYNES and ARTHUR F. ROSE, residing at Woodridge and New Brighton, in the counties of Bergen and Richmond, and States of New Jersey and New York, respectively, have invented certain Improvements in Repeater Cord-Circuits, of which the following is a specification.

This invention relates to telephone systems and more particularly to the supervisory signaling arrangements associated with repeater cord circuits employed in such systems.

It is one of the purposes of the invention to provide a repeater cord circuit which may be connected either with long distance lines or with toll switching trunks and thereby provide a cord circuit which may be used at one end of a long distance call as well as at some intermediate point in a connection. A further purpose is to provide supervisory signaling apparatus for a repeater cord circuit of this type which will operate satisfactorily for both kinds of connections and furthermore which will cause no appreciable disturbance in the condition of balance existing between the repeater apparatus and the cord and the balancing artificial line associated with the line with which a connection is made. Other and further features of the invention will appear more fully from the detailed description hereinafter given.

When the repeater cord circuit of this invention is associated with a toll switching trunk, relay means controlled by a circuit completed to ground over the sleeve of the network jack associated with the toll switching trunk are operated and complete a direct current bridge across the talking conductors of the cord circuit. By means of this direct current bridge the supervisory signaling apparatus in the cord may be controlled by the battery which is normally applied to the talking conductors of the switching trunk and which is disconnected therefrom when the subscriber answers. At the same time the sleeve circuit serves to operate additional relay means whereby a network is bridged across the network conductors of the cord circuit, this network having an impedance equal to that of the direct current bridge completed across the talking conductors and thereby preventing the condition of balance

existing in the repeater set from being disturbed by the including in the talking circuit of the direct current supervisory bridge. The above described supervisory signaling apparatus suitable for a connection with a toll switching trunk is not suitable when the cord circuit is connected with a long distance line as battery is not normally connected to the talking conductors of such a line and disconnected therefrom upon the response of the subscriber. Accordingly the sleeve of the network jack associated with a long distance line is constructed without a connection to ground and when the repeater cord circuit is connected with such a line the above mentioned supervisory signaling apparatus will not operate. The cord circuit repeater accordingly is provided with the usual supervisory signaling arrangements which operate when a connection is established with a long distance line.

The invention may be more fully understood from the following description taken in connection with the accompanying drawing, in the Figures 1 and 2 of which is illustrated a circuit diagram embodying a preferred form of the invention.

In Fig. 2 is illustrated a repeater cord circuit terminating in Fig. 1 in the plugs P_1 and P_2 . Associated with plug P_2 is the jack J_2 of the incoming end of a long distance line L_3 . Only a portion of the line L_3 essential for an understanding of this invention is illustrated. Associated with the incoming end of line L_3 is the network N_3 adapted to balance the line L_3 . Associated with the plug P_1 are the jacks J_1 and J_3 . Associated with jack J_3 is shown a portion of an outgoing end of a long distance line L_2 and the balancing network N_2 for said line. Associated with jack J_1 is a toll switching trunk 1 and the network N_1 for balancing said toll switching trunk. The toll switching trunk 1 terminates in plug P_3 . A subscriber's station 2 is illustrated, terminating in the jack J_4 which is adapted to co-act with plug P_3 . Associated with the sleeve conductor 8 of plug P_1 are the relays 9 and 10. When the plug P_1 is inserted in the jack J_1 the relays 9 and 10 will be operated. The relay 9 completes a direct current bridge 12 across the talking conductors 4 and 5 associated with the plug P_1 . Controlled by the direct current bridge 12 is the relay 11, which in turn

controls the supervisory signal 13. The operation of relay 10 serves to complete across the networks conductors 6 and 7 of plug P_1 a bridge including the supplementary network N_{11} . The network N_{11} has an impedance approximately equal to the impedance of the direct current bridge 12, and serves to prevent the condition of balance in the repeater set from being disturbed when the bridge 12 is completed across the talking conductors 4 and 5. In the repeater set is illustrated the usual type of two element, two-way repeater comprising the vacuum bulb amplifiers A_1 and A_2 , although other types of repeaters such as mechanical repeaters might be employed in place of the vacuum bulb elements A_1 and A_2 . Included in the repeater cord circuit are the ringing keys K_1 and K_4 , the key K_2 whereby the operator's supervisory apparatus may be connected to the monitoring coils 14, 15, 16 and 17, and the splitting key K_3 whereby the operator can talk in either direction. When a connection is established between two long distance lines by the repeater cord circuit, the customary supervisory signaling apparatus is provided, comprising the supervisory signal 28 and the relays 22, 23, 24, 25, 26 and 27, and the ringing responsive relays 18 and 19.

The invention may be more fully understood from the following description of its operation. When a connection is established between two long distance lines such as lines L_3 and L_2 by means of a repeater cord circuit, the plugs P_2 and P_1 are inserted in the jacks J_2 and J_3 , respectively. The insertion of plug P_1 in jack J_3 closes the following circuit: from ground, sleeve conductor of jack J_3 , sleeve contacts of jack J_3 and plug P_1 , conductor 3, winding of relay 22, to battery and ground. The closing of this circuit will operate relay 22. The insertion of plug P_2 in jack J_2 will close the following circuit: from ground, sleeve conductor of jack J_2 , sleeve contacts of jack J_2 and plug P_2 , conductors 29 and 30, winding of relay 23, to battery and ground. The closing of this circuit will operate the relay 23. The operation of relays 22 and 23 will close the following circuit: from ground, lower contact and armature of relay 22, conductors 31, 32, 33, armature and contact of relay 19, conductor 34, contact and armature of relay 18, conductor 35, winding of relay 25, to battery and ground. The closing of this circuit will operate the relay 25, which will pull up its armature and hold open at the contact point 36, a circuit which would otherwise have been completed for the relay 26, as will be pointed out later, and thereby preventing the supervisory signal lamp 28 from being operated. Whenever for supervisory purposes during the conversation or at the end of a conversation ringing current from one of the long distance lines is transmitted back over the talking conductors of such a line this ringing current will operate either of the ringing responsive relays 18 and 19 which are bridged across the talking conductors of the cord circuit. The operation of either of relays 18 and 19 will open at their contact points the previously described circuit about the winding of relay 25, thereby deenergizing relay 25. Upon the deenergization of relay 25 ground will be applied from conductor 33 over contact point 36, armature of relay 25, winding of relay 26, to battery and ground. The closing of this circuit will operate relay 26. Upon the operation of relay 26 ground will be applied from conductor 33 over the contact and armature of relay 26, over conductor 37, winding of relay 24, to battery and ground. The closing of this circuit will operate relay 24 which will pull up its armatures and close the following circuit: from ground, lower armature and contact of relay 24, conductor 38, filament of signal lamp 28, to battery and ground. The closing of this circuit will operate the supervisory lamp 28 and thereby indicate that signaling current is being transmitted over one of the long distance lines. The relay 24 will be locked up over the following circuit: from ground and battery, winding of relay 24, upper contact and armature of relay 24, conductor 39, contact of key K_2 , conductor 40, conductor 41, conductors 32 and 31, armature and contact of relay 22, to ground.

If a connection is established between the long distance line L_3 and the toll switching trunk 1 by means of the repeater cord circuit the plugs P_2 and P_1 will be inserted in the jacks J_2 and J_1 , respectively. The supervisory signaling arrangements controlling the signal lamp 28 will operate in the same manner as previously described, and the signal lamp 28 will be controlled by ringing current transmitted over line L_3 and through the winding of the ringing responsive relay 19 in the same manner as previously pointed out. When the plug P_1 is inserted in the jack J_1 the following circuit is closed. From ground, sleeve conductor of network jack J_1 , sleeve contacts of network jack J_1 and plug P_1 , conductor 8, conductor 42, winding of relay 9, to battery and ground; and also from conductor 8, over conductor 43, winding of relay 10, to battery and ground. The closing of these circuits will operate relays 9 and 10. The operation of relay 9 will complete a direct current bridge 12 across the talking conductors 44 and 45 of the repeater cord circuit. This direct current bridge includes the winding of relay 11. When a connection is made with the toll switching trunk 1 by inserting the plug P_1 in the jack J_1 and before the subscriber at substation 2 has removed the receiver from the switch hook battery is

normally applied to the talking conductors of the toll switching trunk and the repeater cord circuit over the following circuit: from ground, lower winding of relay 46, lower contact of relay 47, conductor 48, upper left-hand winding of transformer 49, tip conductor of trunk 1, tip contacts of jack J_1 and plug P_1 , conductor 4, normal contact of key K_1 , conductor 45, armature and make contact of relay 9, direct current bridge 12, make contact and armature of relay 9, conductor 44, normal contact of key K_1 , conductor 5, ring contacts of plug P_1 and jack J_1 , ring conductor of trunk 1, lower left-hand winding of transformer 49, conductor 50, upper contact and armature of relay 47, upper winding of relay 46, to battery and ground. As the winding of relay 11 is included in the direct current bridge 12 of the circuit just traced, the relay 11 will be operated and will close the circuit for and operate the supervisory lamp 13. Upon the completion of the previously traced circuit, the relay 46 will also be operated. When the operator throws the ringing key K_1 in the cord ringing current transmitted over the talking conductors will operate relay 51. The operation of relay 51 closes the following circuit: from ground, armature and contact of relay 51, conductor 53, winding of relay 54, conductor 55, winding of relay 47, to battery and ground. The closing of this circuit operates the relay 54 which applies ringing current to the talking conductors of trunk 1 and to the signaling apparatus at the substation 2. The closing of the above circuit also operates relay 47. When relay 47 is operated, the relay 46 will still remain energized over the following circuit: from ground, lower winding of relay 46, lower contact and armature of relay 47 to battery and ground. Accordingly when the aforementioned circuit for relay 46 is opened by the ringing key K_1 or by the operation of relay 47, the relay 46 will not be deenergized, but will remain operative. When the subscriber at substation 2 in response to the ringing signal removes the receiver from the switch hook, the following circuit will be completed: from ground and battery, winding of relay 52, out over the ring conductors of trunk 1 and the line leading to substation 2, through the substation apparatus and back over the tip conductor leading from substation 2 and over the tip conductor of trunk 1, to ground. The closing of this circuit will operate relay 52. Upon the operation of relay 52 the following circuit will be closed: from ground and battery, lower winding of relay 47, conductors 55 and 56, contact and armature of relay 52, conductor 57, upper winding of relay 47, conductor 58, contact and armature of relay 46 to ground. The closing of this circuit will operate relay 47, which will pull up its armatures and

thereby disconnect battery from the talking conductors of trunk 1, and accordingly from conductors 4 and 5. The disconnection of battery from this circuit will deenergize relay 11, which was included therein, and accordingly will allow the signal lamp 13 to be extinguished. When the connection is completed and the subscriber at substation 2 restores the receiver to the switch hook the relay 52 is deenergized and causes the deenergization of relay 47. Upon the deenergization of relay 47 battery is again applied to the talking conductors of trunk 1 and conductors 4 and 5, and the relay 11 is energized, thereby operating the signal lamp 13 and indicating that the connection has been terminated.

It is pointed out that the completion of the direct current bridge 12 across the talking conductors 4 and 5 and 44 and 45 of the repeater cord circuit would tend to disturb the condition of balance existing in the repeater set between the trunk 1 and its balancing artificial line N_1 . As has been formerly pointed out the relay 10 is provided which operates whenever the relay 9 is operated, and which when operated serves to complete across the network conductors 6 and 7 a bridge including the network N_{11} . The network N_{11} has an impedance equal to the impedance of the direct current bridge 12 and accordingly serves to prevent any disturbance in the condition of balance in the repeater set between the trunk 1 and the network N_1 caused by the association therewith of the bridge 12. It is pointed out that the relays 9 and 10 and the supervisory signaling apparatus associated therewith will not be operated when the plug P_1 is inserted in the jack such as the jack J_3 of a long distance line L_2 , as the sleeve of the network jack associated with such a line is not provided with a connection to ground. Accordingly the supervisory signaling arrangements of the cord circuit suitable for use in connection with a toll switching trunk will remain inoperative when the cord circuit is associated with a long distance line.

While the invention has been disclosed in certain specific arrangements which have been deemed desirable, it is 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 claims.

What is claimed is:

1. In a telephone system, a toll switching trunk terminating at a central office, a balancing network associated with said trunk, a source of battery supply normally connected to the talking conductors of said trunk, a subscriber's line associated with said trunk, means controlled by said subscriber's line for disconnecting said battery supply from said trunk, a cord circuit at said cen-

tral office including repeater apparatus and adapted for establishing connections with said trunk, means controlled by the connection of said cord with said trunk for completing a direct current bridge across the talking conductors of said cord, relay means in said bridge, supervisory signaling apparatus controlled by said relay, means controlled by the connection of said cord with said trunk for completing a bridge across the network conductors of said cord, and means for making the impedances of both of said bridges approximately equal.

2. In a telephone system, a toll switching trunk terminating at a central office, long distance lines terminating at said central office, balancing networks associated with said trunk and said lines, a source of battery supply normally connected to the talking conductors of said trunk, a subscriber's line associated with said trunk, means controlled by said subscriber's line for disconnecting said battery supply from said trunk, a cord circuit at said central office including repeater apparatus and adapted for establishing connections between two of said long distance lines and between one of said long distance lines and said toll switching trunk, means controlled by the connection of said cord with said trunk for completing a direct current bridge across the talking conductors of said cord, relay means in said bridges, supervisory signaling apparatus controlled by

said relay, means controlled by the connection of said cord with said trunk for completing a bridge across the network conductors of said cord, means for making the impedances of both of said bridges approximately equal, additional supervisory signaling apparatus included in said cord circuit, and means controlled by the connection of said cord with said long distance lines or with one of said lines and said trunk for rendering operative said additional supervisory signaling apparatus.

3. In a telephone system, a toll switching trunk terminating at a central office, a cord circuit at said central office including repeater apparatus and adapted for establishing connections with said trunk, means responsive to the connection of said cord with said trunk for completing a bridge across the talking conductors of said cord and for completing a bridge across the network conductors of said cord, supervisory signaling apparatus controlled by said first mentioned bridge, and an impedance element included in said second mentioned bridge having an impedance approximately equal to the impedance of said first mentioned bridge.

In testimony whereof, we have signed our names to this specification this 19th day of September 1919.

OWEN H. LOYNES.
ARTHUR F. ROSE.