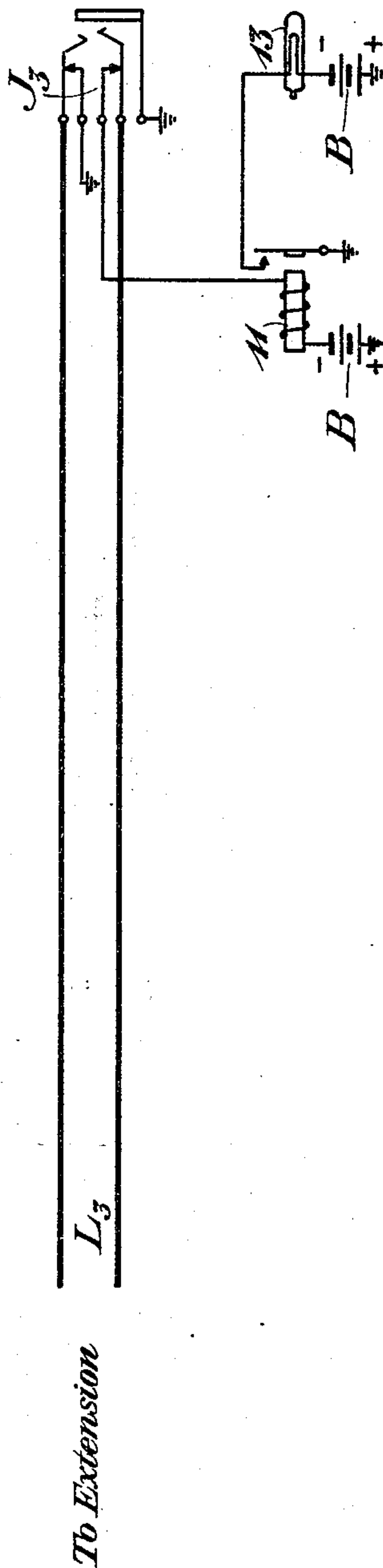
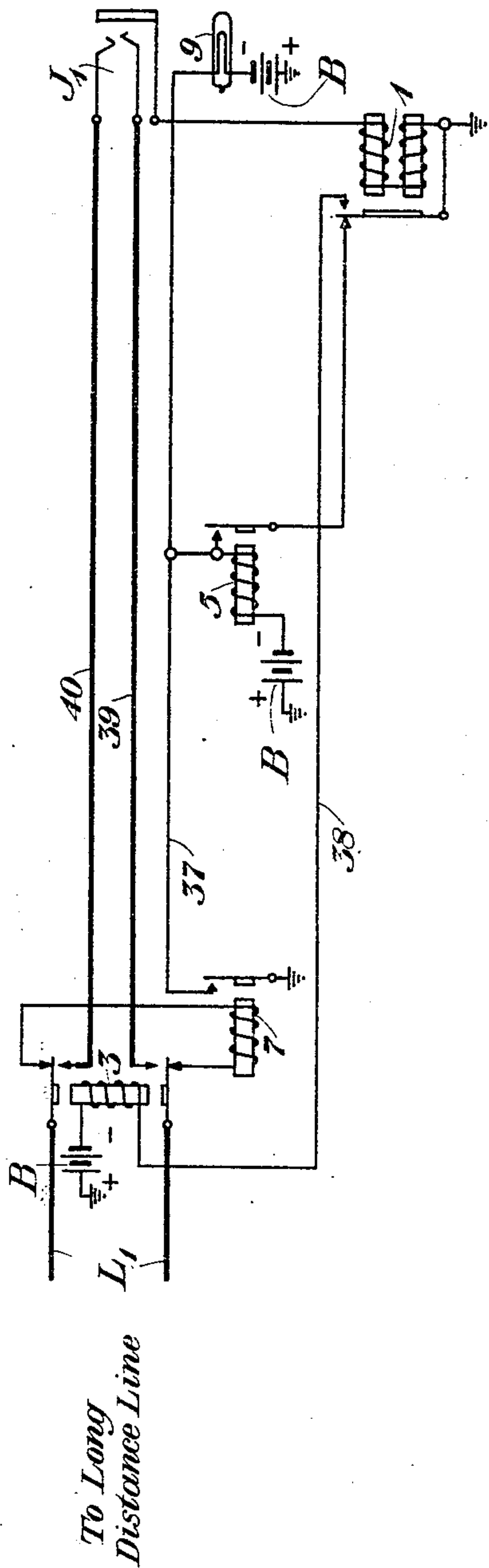


L. H. DARROW.
 SIGNALING SYSTEM.
 APPLICATION FILED OCT. 30, 1917.

1,283,687.

Patented Nov. 5, 1918.

3 SHEETS—SHEET 1.



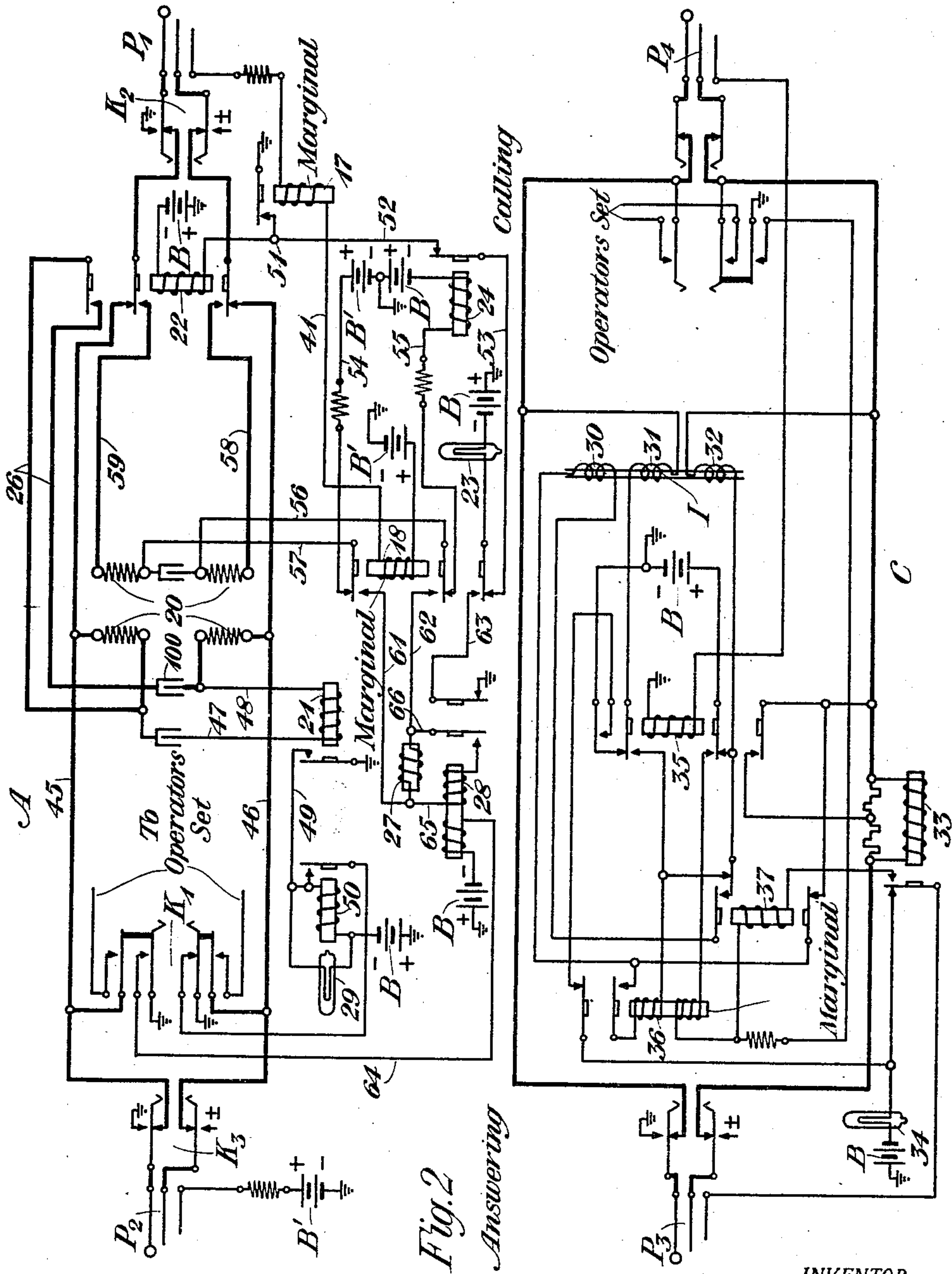
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

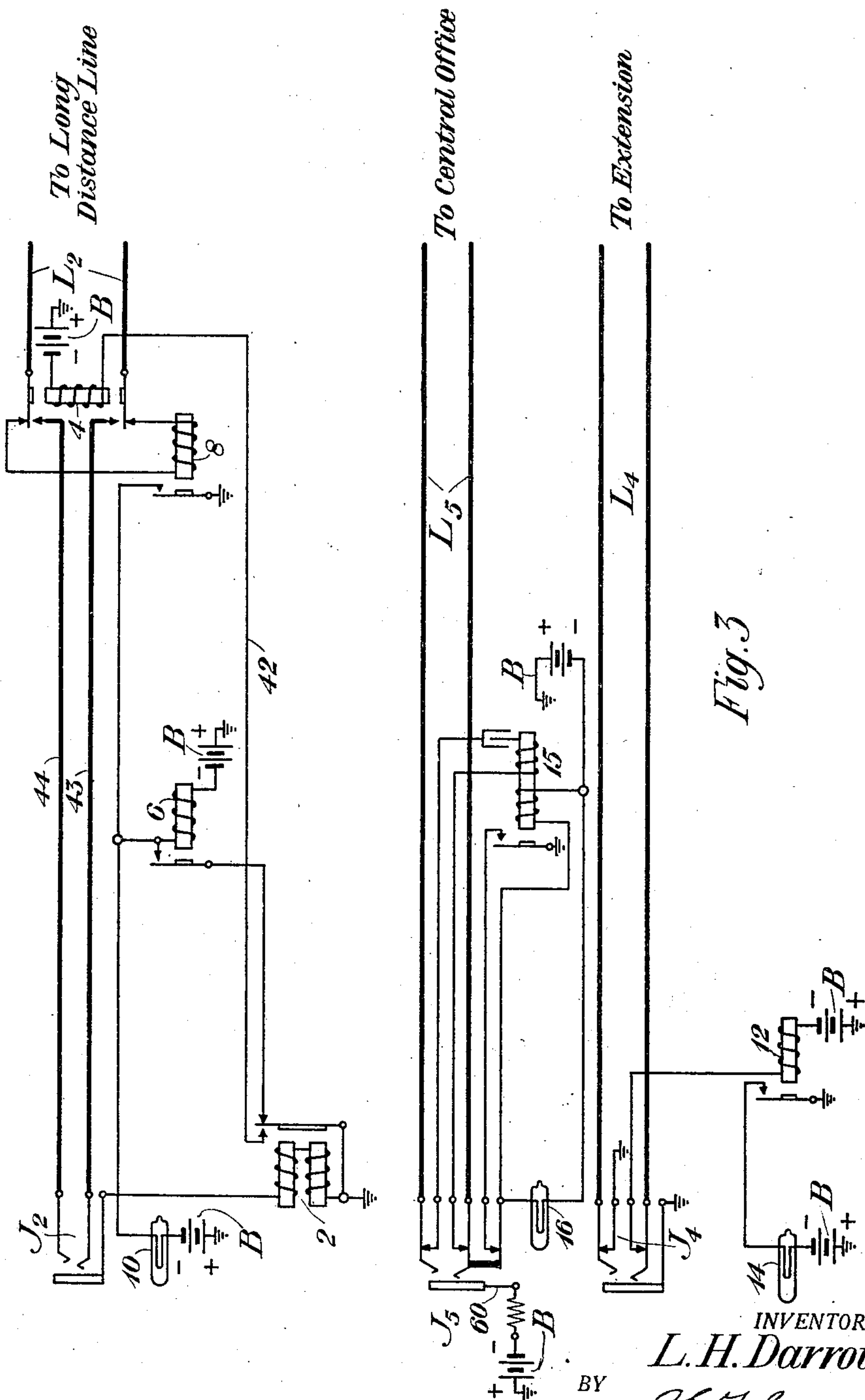


Fig. 3

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UNITED STATES PATENT OFFICE.

LEO H. DARROW, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SIGNALING SYSTEM.

1,283,687.

Specification of Letters Patent.

Patented Nov. 5, 1918.

Application filed October 30, 1917. Serial No. 199,330.

To all whom it may concern:

Be it known that I, LEO H. DARROW, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Signaling Systems, of which the following is a specification.

This invention relates to apparatus for use in connection with telephone switchboards and more particularly relates to equipment for private branch exchange switchboards with which are associated both long distance and local lines.

It is one of the objects of the invention to provide a means whereby a connection, which will insure a good grade of transmission and proper supervision, may be made between two long distance lines terminating at a switchboard, or between a long distance line and one of the local circuits terminating at the switchboard, such as an extension, or between a long distance line and a central office. A further object consists in the provision of apparatus which will prevent a long distance connection from being made with any cord circuit except the proper long distance cord circuit, and thus obviates the possibility of poor transmission and improper supervision, which would result if a local cord circuit were used for a long distance connection. Other and further objects of the invention will be clear from the detailed description to be given later.

Where a private branch exchange switchboard is equipped with private long distance lines as well as local lines, it has been found advantageous in accordance with this invention to add to the customary apparatus at such a switchboard a special type of cord circuit for making long distance connections. This is because it is necessary to provide for a better grade of transmission in the cord circuits used to make long distance connections than is required in the usual type of cord circuit used for local connections. To meet the demand for equipment which will serve such a purpose the cord circuit included in this invention has been provided, together with special apparatus associated with the jacks of the lines terminating at the switchboard. To obtain the best results it is provided that only when the long distance cord circuit is used, can a long distance connection be completed. For this purpose there is connected to the sleeve con-

tact of each of the jacks of the long distance lines a relay responsive to current of definite polarity only. These polarized relays control mechanisms to connect or disconnect the long distance transmission lines and the apparatus terminating at the contacts of the jacks. At the switchboard is located a divided battery which is so connected to the plugs of the long distance and local cord circuits that there are opposite potentials on the sleeve contacts thereof.

The potential on the sleeve contacts of the plugs of the long distance cord circuit is of the proper polarity to operate the aforementioned polarized relays associated with the long distance jacks, which upon functioning allow the long distance connection to be completed. On the other hand the potential applied to the sleeve contacts of the plugs of the local cord circuit is of the opposite polarity and will not operate the aforementioned polarized relays. Accordingly a long distance connection can not be completed by using the local cord circuit. Moreover upon plugging in with the long distance cord there is automatically brought into the circuit apparatus adapted for functioning with the particular type of lines connected. This is accomplished by having such apparatus under the control of two marginal relays with their windings in series in the sleeve conductor of the calling plug of the long distance cord. When this plug is inserted in either a long distance jack, an extension jack, or the central office jack, a different combination of these marginal relays will be caused to function and the desired apparatus under their control will thereby be associated with the circuit.

The invention may now be more fully understood when taken in connection with the accompanying drawing in which the Figures 1, 2, and 3 when arranged side by side in numerical order illustrate diagrammatically the preferred form of the invention. In the Figs. 1 and 3 are shown the terminating arrangements of the various types of lines which appear before the operator in the form of jacks located at the switchboard. The jacks shown at the upper portions of the drawing are the type of jack at which the long distance lines terminate, while those illustrated at the lower portions of the drawing are the terminals for local

lines or extensions. The jack shown in the middle portion of Fig. 3 is the type of jack suitable for use with a trunk connected to a central office. In the Fig. 2 are shown the two types of cord circuits to be used at the switchboard. The cord circuit C shown in the lower portion of the figure is the type of local cord circuit which may be used to make connections between local circuits terminating at the switchboard or between a local circuit and the central office. The cord circuit A shown in the upper portion of the drawing is the long distance cord circuit embodied in the arrangements of this invention. The long distance cord circuit A may be employed to make connections between two long distance lines terminating at the switchboard, or between a long distance line and one of the local circuits terminating at the switchboard, or between a long distance line and the central office.

Connected to the sleeve contacts of the long distance jacks J_1 and J_2 are the relays 1 and 2 which are constructed to respond only to current of a certain polarity. These polarized relays control the operation of the cut off relays 3 and 4 which serve to connect the transmission lines to the terminals of the jacks at the switchboard. The relays 5 and 7, and 6 and 8, control the operation of the line signal lamps 9 and 10 respectively. Associated with the extension jacks J_3 and J_4 are shown the usual relays 11 and 12 under control of which are the line signal lamps 13 and 14 respectively. Included in the arrangements of the central office jack J_5 is the relay 15 having a double winding. One winding of this relay responds to ringing current from the central office and the operation of the relay controls the signal lamp 16. An auxiliary circuit for locking up the relay 15 is shown which includes the battery B and the second winding of the relay.

Included in the long distance cord circuit A are the calling and answering plugs P_1 and P_2 respectively. Connected to the sleeve of the plug P_2 is a battery B' so poled as to furnish current of the proper polarity for operating the polarized relay 1. In the conductor terminating in the sleeve contact of the calling plug P_1 are the windings of two marginal relays 17 and 18, these windings being connected in series, and the other terminal of the conductor being connected to the battery B' which is also so poled as to furnish current of the proper polarity to operate the polarized relay 2. When the calling plug P_1 is inserted in one of the long distance jacks, such as jack J_3 , these two marginal relays are not actuated as the polarized relay 2 included in the circuit is of high resistance. Accordingly transmission will take place directly

over the talking conductors of the cord circuit without introducing the repeating coil 20 which is associated therewith and which is controlled by one of said marginal relays. Two of the windings of this repeating coil are included in a bridge across the talking conductors of the cord and include a condenser and the relay 21. When either distant operator rings over the line the relay 21 will operate and cause the signal lamp 29 to glow.

When the calling plug P_1 is inserted in one of the extension jacks, such as jack J_4 , the resistance in the sleeve circuit is sufficiently reduced so that the marginal relay 17 will be caused to operate. This relay controls the operation of the relay 22 which, upon actuation, connects the repeating coil 20 to the talking strands of the plug P_1 . The relay 22 also closes a parallel path including the conductors 26 about the winding of the signal controlling relay 21. Upon the operation of relay 17 a circuit is also closed through the signal lamp 23 which then operates as a supervisory signal. Connected to the right hand windings of the repeating coil 20 is the divided battery B B' which serves to furnish the talking current for the circuit closed through the repeating coil 20 by the releasing of the receiver hook at the extension station. The closing of this last mentioned circuit is indicated by the extinguishing of the signal lamp 23 due to the energization of the relay 24 which is included in the talking circuit.

When the calling plug P_1 is inserted in the central office jack J_5 , both of the marginal relays 17 and 18 will be operated because the battery B included in the sleeve circuit of the jack J_5 is now connected in series with the battery B' in the sleeve circuit of the plug P_1 and the potential is thereby sufficiently increased. The functioning of relay 17 will, as formerly pointed out, cause the repeating coil 20 to be connected to the talking strands of the calling plug and will close a parallel path around the signal controlling relay 21. The operation of the marginal relay 18, however, serves to disconnect the divided battery B B' from the repeating coil as the talking current is now furnished by a source at a distant central office. Instead of being completed through the divided battery B B' as formerly, the circuit is now completed through the retardation coil 27 and the relay 28, which allows supervision on the central office trunk and provides for re-ring signals as will be hereinafter pointed out in the description of the operation.

Included in the usual type of cord circuit illustrated in the lower portion of Fig. 2 are the answering and calling plugs P_3 and P_4 respectively. Connected to the sleeve contact of the answering plug P_3 is the

battery B so poled as to furnish current of a polarity opposite to that furnished by the battery B'; and not suitable to operate the polarized relays 1 and 2 associated with the long distance jacks. As there is no battery connected to the conductor terminating in the sleeve of the calling plug P₁ and as the battery connected to the sleeve of the answering plug P₂ is not of a suitable polarity, the polarized relays 1 and 2 cannot be actuated by the insertion of the plugs P₃ and P₄ in the long distance jacks J₁ and J₂, and accordingly a long distance connection cannot be completed through the local cord circuit. Located in a bridge across the talking conductors of the local cord circuit is the impedance coil 1 including the windings 30, 31, and 32. When a connection is completed between two extension stations, this bridge normally includes the windings 31 and 32 and the battery B, the latter supplying the talking current through the impedance of the two windings. However, when a connection is made between an extension station and the central office the talking current is supplied from a source at the central office instead of from the battery B located at the private branch exchange board. Accordingly by means of the relay 35 connected to the sleeve of the plug P₁ the battery B is disconnected from the windings of the impedance coil 1 and the locking winding of a supervisory relay 36 is substituted therefor. By means of the relays 36 and 37 the winding 30 is added to the bridge, thereby sufficiently increasing the impedance to prevent talking current from being shunted therethrough. Connected to the sleeve of the plug P₃ is the signal lamp 34 so arranged that a circuit would normally be closed therethrough upon the insertion of the plug P₃ in the jack J₃ were it not for the fact that this circuit is held open by the energization of the relay 33 associated with one of the talking conductors of the cord circuit. The relay 33 is energized by the current flowing over the talking conductors through the calling subscriber's bridge. When the calling subscriber hangs up his receiver, the relay becomes deenergized and its armature retracts and allows the circuit through the signal lamp 34 to be completed. By the above described means the operator at the switchboard may be informed when a conversation between two extension stations has been terminated. When a connection is made between an extension station and the central office the operation of the signal lamp 34 may be controlled either by the relay 33 or by the relay 36 which is bridged across the line over the contacts of relays 35 and 37. By such arrangements the operator at the private branch exchange board may be informed when the connection is terminated at the extension station, or when

a recall is desired by the central office. As the local cord circuit thus briefly described is of the usual type and does not constitute a part of this invention, no further description thereof will be necessary and the description of its operation will be omitted.

The invention may now be more fully understood from the following description of its operation. If a call is originated from the distant end over one of the long distance lines such as, for example, the line L₁, ringing current will be transmitted over the line L₁ and the winding of relay 7, which will be energized and pull up its armature thereby closing the following circuit: from ground, armature and contact of relay 7, over conductor 37, filament of signal lamp 9 to battery B and ground. This causes the signal lamp 9 to glow and the operator at the private branch exchange is thereby notified that a connection is desired. The pulling up of its armature by relay 7 also closes a circuit through the winding of relay 5 to battery B and ground, causing relay 5 to become energized and pull up its armature and close a locking circuit for the signal lamp 9 over the conductor leading to the left hand contact and armature of the polarized relay 1 to ground. In response to the glowing of signal lamp 9 the operator inserts the answering plug P₂ of the long distance cord circuit A in the jack J₁, thereby closing the following circuit: from ground and battery B', over conductor leading to the sleeve of plug P₂, sleeve contacts of plug P₂ and jack J₁, over conductor leading from sleeve of jack J₁, winding of polarized relay 1 to ground. As the current furnished by the battery B' is of the proper polarity, the closing of the above described circuit causes the polarized relay 1 to become energized and thereby closes a circuit from ground, armature and right hand contact of relay 1, conductor 38, winding of relay 3, to battery B and ground. This energizes relay 3 which pulls up its armatures, thereby disconnecting the long distance transmission line L₁ from the conductors leading to the winding relay 7 and connecting the transmission line to the conductors terminating in the tip and ring contacts of the jack J₁. The energization of the polarized relay 1 also serves to extinguish the line signal lamp 9 as the locking circuit formerly closed therethrough over the left hand contact and armature of relay 1 is broken by the energization of said relay. The operator by now throwing her listening key K₁ may establish a connection between the operator's set and the calling station over the contacts of key K₁, talking strands of cord circuit A, contacts of plug P₂ and jack J₁, conductors 39 and 40, contacts and armatures of relay 3, and over the long distance transmission line to the calling station. The operator may then ascertain

whether a connection with another long distance line, with an extension station, or with a central office is desired.

If the connection desired is with another long distance line, as for example the line L_2 terminating at the switchboard in the jack J_2 , the operator inserts the calling plug P_1 of the long distance cord circuit in the jack J_2 . This closes the following circuit; from ground and battery B' , winding of relay 18, conductor 41, winding of relay 17, conductor leading to sleeve of plug P_1 contacts of plug P_1 and jack J_2 , winding of polarized relay 2 to ground. As the current furnished by the battery B' is of the proper polarity, the closing of the above described circuit will cause the polarized relay 2 to become energized and pull up its armature thereby closing the following circuit; from ground, armature and left hand contact of relay 2, conductor 42, winding of relay 4, to battery B and ground. The closing of this circuit energizes relay 4 which pulls up its armatures and connects the long distance transmission line L_2 to the conductors 43 and 44 leading to the tip and ring contacts of jack J_2 . The operator then throws the ringing key K_2 and sends ringing current over the long distance transmission line L_2 . The called station now responds to this ringing current and a connection is completed between the two long distance stations over the following circuit; from the calling station, over the long distance transmission line L_1 , to armatures and contacts of relay 3, over conductors 39 and 40, tip and ring contacts of jack J_2 and plug P_2 , closed contacts of ringing key K_3 , over the talking strands 45 and 46 of the cord circuit, contacts and armatures of relay 22, closed contacts of ringing key K_2 , tip and ring contacts of plug P_1 and jack J_2 , conductors 43 and 44, contacts and armatures of relay 4, and thence over the long distance transmission line L_2 to the called station. When the long distance call is terminated by either subscriber hanging up his receiver the operator at the distant central office associated locally with the subscriber's set is notified thereof by the usual type of line signal and thereupon sends ringing current back over the talking circuit to the private branch exchange herein illustrated. This ringing current passes over the talking strands 45 and 46 of the long distance cord circuit and over the bridge across said talking strands. This bridge includes the left hand windings of the repeating coil 20, the conductors 47 and 48, a condenser, and the winding of relay 21. The relay 21 is adapted to respond to ringing current and is accordingly energized and by pulling up its armature closes the following circuit; from ground, armature and contact of relay 21, over conductor 49, filament of signal

lamp 29, to battery B and ground. The closing of the above described circuit causes the signal lamp 29 to glow and the operator at the private branch board is thereby informed that the long distance call has been terminated. Associated with the signal lamp 29 is the relay 50 which becomes energized by the actuation of the ringing responsive relay 21 and by pulling up its armature becomes permanently energized by closing the following circuit; from ground and battery B, winding of relay 50, contact and armature of relay 50, and thence over the conductor leading to contact of key K_1 and ground. This energization of relay 50 also closes an auxiliary circuit through the signal lamp 29 and causes it to glow after the ringing current has ceased and until the private branch exchange operator breaks the circuit therethrough by throwing the key K_1 .

If the operator at the private branch exchange ascertains that a connection is desired by the calling subscriber on the long distance line with one of the extension lines, as for example the line L_4 terminating at the switchboard in the jack J_4 , she inserts the calling plug P_1 of the long distance cord circuit in the extension jack J_4 and by throwing the ringing key K_2 transmits ringing current over the line L_4 to the extension station. When the plug P_1 is inserted in the jack J_4 the following circuit is closed; from ground and battery B' , winding of marginal relay 18, conductor 41, winding of marginal relay 17, sleeve contacts of plug P_1 and jack J_4 , to ground. When the plug P_1 was inserted in the jack J_2 the circuit closed through the windings of the marginal relays 17 and 18 included the high resistance of the polarized relay 2 and the marginal relays 17 and 18 were not energized. However, in the above described circuit closed through the marginal relays 17 and 18 by the insertion of the plug P_1 in the jack J_4 the resistance is sufficiently reduced, as the sleeve contact of jack J_4 is directly grounded, so that the marginal relay 17 is caused to respond. The actuation of the marginal relay 17 closes the following circuit; from ground, armature and contact of relay 17, conductor 52, contact and armature of relay 24, conductor 53, contact and armature of relay 18, filament of signal lamp 23, to battery B and ground. By the closing of the above described circuit the signal lamp 23 will be caused to glow. The actuation of relay 17 also closes the following circuit; from ground, armature and contact of relay 17, to connecting point 51, thence through the winding of relay 22 to battery B and ground. The closing of this last mentioned circuit energizes relay 22 which by pulling up its armatures disconnects the talking strands 45 and 46 of the cord circuit from the conductors leading to the tip and ring

contacts of the plug P_1 and connects said conductors to the conductors 58 and 59 which lead to the right hand winding of the repeating coil 20, thereby associating the repeating coil with the talking circuit—connected to the right hand windings of the repeating coil 20 by conductors 56 and 57, armatures and contacts of relay 18, and conductors 55 and 54 is the divided battery $B B'$, which serves to furnish the talking current for the extension line through the right hand winding of the repeating coil 20. When the called subscriber at the extension station removes the receiver from the hook in response to the ringing signal, a talking circuit will be closed through the right hand windings of the repeating coil 20 as follows; from ground and battery B' , conductor 54, contact and armature of relay 18, conductor 20, 57, upper right hand winding of repeating coil 20, conductor 59, contact and armature of relay 22, conductor leading to tip of plug P_1 , thence through the extension station and back to ring contact of plug P_1 by way of line L_1 and contacts of jack J_4 , over conductor leading from ring contact of plug P_1 , armature and contact of relay 22, conductor 58, lower right hand winding of repeating coil 20, conductor 56, armature and contact of relay 18, conductor 55, winding of relay 24, to battery B and ground. The bridge across the talking strands of the cord circuit which includes the left hand windings of the repeating coil 20 is now completed in a different manner by the aforementioned energization of relay 22. While normally this bridge was completed through the winding of the ringing responsive relay 21, the pulling up of its upper armature by relay 22 closes a parallel path around the winding of said ringing responsive relay by means of the conductors 26 and the condenser 100, so that this bridge is now completed through the upper left hand winding of repeating coil 20, over conductors 26 and condenser 100, and thence through the lower left hand winding of repeating coil 20. The condenser 100 is so proportioned as to readily allow the transmission over this bridge of currents suitable for telephone purposes, but offers a high enough impedance to low frequency ringing currents to prevent them from being transmitted over this parallel path and to cause them to be transmitted through the winding of the ringing responsive relay 21 as previously pointed out. Accordingly the above described arrangements provide a low impedance path through said bridge for telephonic currents, while at the same time allowing the signal lamp 29 to be operated by ringing current from the long distance line. In order that the operator may be informed when the connection has been terminated at the extension station the following signaling means are

provided for this purpose. When the talking circuit through the right hand windings of the repeating coil 20 is closed, the relay 24 having its winding included serially in said talking circuit becomes energized and by pulling up its armature opens the circuit which was closed through the lamp 23 upon the aforementioned energization of the marginal relay 17. As soon as the subscriber at the extension station terminates the connection and breaks the talking circuit through the right hand windings of the repeating coil 20 by hanging up his receiver, the relay 24 becomes deenergized and by allowing its armature to retract causes the above mentioned circuit through the signal lamp 23 to be completed, whereupon the glowing of the signal lamp 23 will inform the operator of the termination of the connection.

If the operator at the private branch exchange ascertains that a connection is desired by the calling subscriber on the long distance line with a central office, such as is herein illustrated as being associated with the private branch switchboard by the trunk line L_5 and the jack J_5 , she inserts the calling plug P_1 of the long distance cord circuit in the jack J_5 . When the plug P_1 is inserted in the jack J_5 the following circuit is closed: from ground, battery B' , winding of marginal relay 18, conductor 41, winding of marginal relay 17, sleeve contacts of plug P_1 and jack J_5 , conductor 60 to battery B and ground. As the above described circuit is closed through the windings of the marginal relays 18 and 17 includes in series the battery B' and the battery B , the potential is sufficient to cause both of these marginal relays to become energized. As has been formerly pointed out in greater detail, the energization of the marginal relay 17 serves to disconnect the talking strands of the long distance cord circuit from the conductors terminating in the tip and ring contacts of plug P_1 and connects the latter to the conductors 58 and 59 leading to the right hand winding of the repeating coil 20, thereby including the right hand windings of the repeating coil in the central office talking circuit. Also in the same manner as formerly pointed out, the energization of marginal relay 17 causes a parallel path to be closed about the winding of ringing responsive relay 21 and completes the bridge including the left hand windings of the repeating coil through said parallel path. The energization of marginal relay 18 causes it to pull up its armatures thereby disconnecting the divided battery $B B'$ from the right hand windings of the repeating coil, as the talking current for this connection will be furnished from a source at a distant central office. Accordingly the talking circuit is now completed over the central office trunk and the

right hand windings of the repeating coil 20 as follows: from upper right hand winding of repeating coil 20, over conductor 57, armature and contact of relay 18, conductor 61, retardation coil 27, conductor 62, contact and armature of relay 18, conductor 56, to the lower right hand winding of repeating coil 20. The insertion of plug P_1 in the jack J_3 and the completing of the above described circuit operates the customary line relay and signal located at the central office and informs the central office operator that a connection is desired. The pulling up of its lower armature by relay 18 connects the signal lamp 23 to the conductor 63 and places the signal lamp 23 under the control of relay 28. When the operator throws her listening key K_1 a circuit is closed through the left hand winding of relay 28 as follows; from ground and contact of key K_1 , conductor 64, left hand winding of relay 28, battery B to ground. This causes the relay 28 to become energized and by pulling up its armature its right hand winding becomes included in the central office talking circuit by means of the conductors 65 and 66. Accordingly if the operator releases her listening key K_1 and thereby breaks the circuit through the left hand winding of relay 28, the relay will still remain energized as long as its right hand winding is included in the central office talking circuit. When a re-ring signal is desired the central office operator throws her ringing key and sends ringing current over the talking circuit and through the winding of relay 28, instead of the direct current used for talking purposes. As the relay 28 will not respond to the alternating current used for ringing purposes it will become de-energized and allow its right hand armature to retract thereby closing the following circuit; from ground, right hand armature of relay 28, conductor 63, contact and lower armature of relay 18, filament of signal lamp 23, battery B, to ground. Accordingly the private branch exchange operator is notified of the re-ring signal by the glowing of signal lamp 23.

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

What is claimed is:

1. In a telephone system, a switching station, a plurality of local lines, trunks leading to main offices, and a plurality of long distance lines terminating at said switching station, switching means at said station whereby local lines may be interconnected and whereby a local line may be connected to a trunk, a second switching means adapted to interconnect two long distance lines, a long distance line and a trunk, and a long

distance line and a local line, and means associated with the long distance lines and said second switching means to prevent the effective use of said first mentioned switching means to establish a connection with any of said long distance lines.

2. In a telephone system, a switching station, a plurality of local lines, long distance lines, and trunks leading to central offices, having terminal arrangements at said switching station, two cord circuits to connect various combinations of said terminal arrangements, a divided battery located at said switching station and so connected to said cord circuits that there are opposite potentials on the sleeve conductors of the plugs thereof, polarized relays with their windings in the sleeve conductors of each terminal arrangement of said long distance lines, said polarized relays being actuated only when the plugs of a certain one of said cord circuits are associated with said long distance terminal arrangements, and said polarized relays controlling means whereby said long distance lines may be connected to or disconnected from their respective terminal arrangements.

3. In a telephone system, a switching station, a plurality of local lines, trunks leading to main offices, and a plurality of long distance lines terminating at said station, a cord circuit adapted for establishing connections involving said long distance lines, two marginal relays in the sleeve conductor of a plug of said cord circuit, neither of said relays being actuated when said plug is associated with one of said long distance lines, one of said relays being actuated when said plug is associated with one of said local lines, and both of said relays being actuated when said plug is associated with a trunk line.

4. In a telephone system, a switching station, a plurality of local lines, trunks leading to main offices, and a plurality of long distance lines terminating at said station, a cord circuit adapted for establishing connections involving said long distance lines, two marginal relays in the sleeve conductor of a plug of said cord circuit, neither of said relays being actuated when a connection is made with a long distance line, one of said relays being actuated when a connection is made with a local line, signaling means under the control of said relay for indicating the termination of said connection, both of said relays being actuated when a connection is made with a trunk line, and signaling means under the control of said relays for indicating a re-ring from said trunk.

5. In a telephone system, a switching station, a plurality of local lines, trunks leading to main offices, and a plurality of long distance lines terminating at said station, a cord circuit adapted for establishing con-

nections involving said long distance lines, marginal relays with their windings included in a sleeve conductor of said cord circuit, means under the control of said marginal relays whereby, when a connection is made with a long distance line, transmission may take place directly over the talking strands of said cord circuit, and whereby, when a connection is made with a main office, transmission will take place through a repeating coil associated with said cord circuit, and whereby, when a connection is made with a local line, transmission over the cord circuit will take place through a repeating coil with which is associated a source of high potential battery supply.

6. In a telephone system, a switching station, a plurality of local lines, trunks leading to main offices, and a plurality of long distance lines terminating at said station, a cord circuit adapted for establishing connections involving said long distance lines, two marginal relays in the sleeve conductor of a plug of said cord circuit, neither of said

relays being actuated when said plug is associated with one of said long distance lines, and means under the control of said relays when unactuated whereby transmission will take place over the talking strands of said cord circuit, one of said relays being actuated when said plug is associated with one of said local lines, and means under the control of said relay when actuated whereby transmission over said cord circuit will take place through a repeating coil with which is associated a source of high potential battery supply, both of said relays being actuated when said plug is associated with a trunk line, and means under the control of said relays when actuated whereby said aforementioned repeating coil is associated with said cord circuit and whereby said source of high potential battery supply is disconnected from said repeating coil.

In testimony whereof, I have signed my name to this specification this 24th day of October, 1917.

LEO H. DARROW.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."