

Aug. 14, 1928.

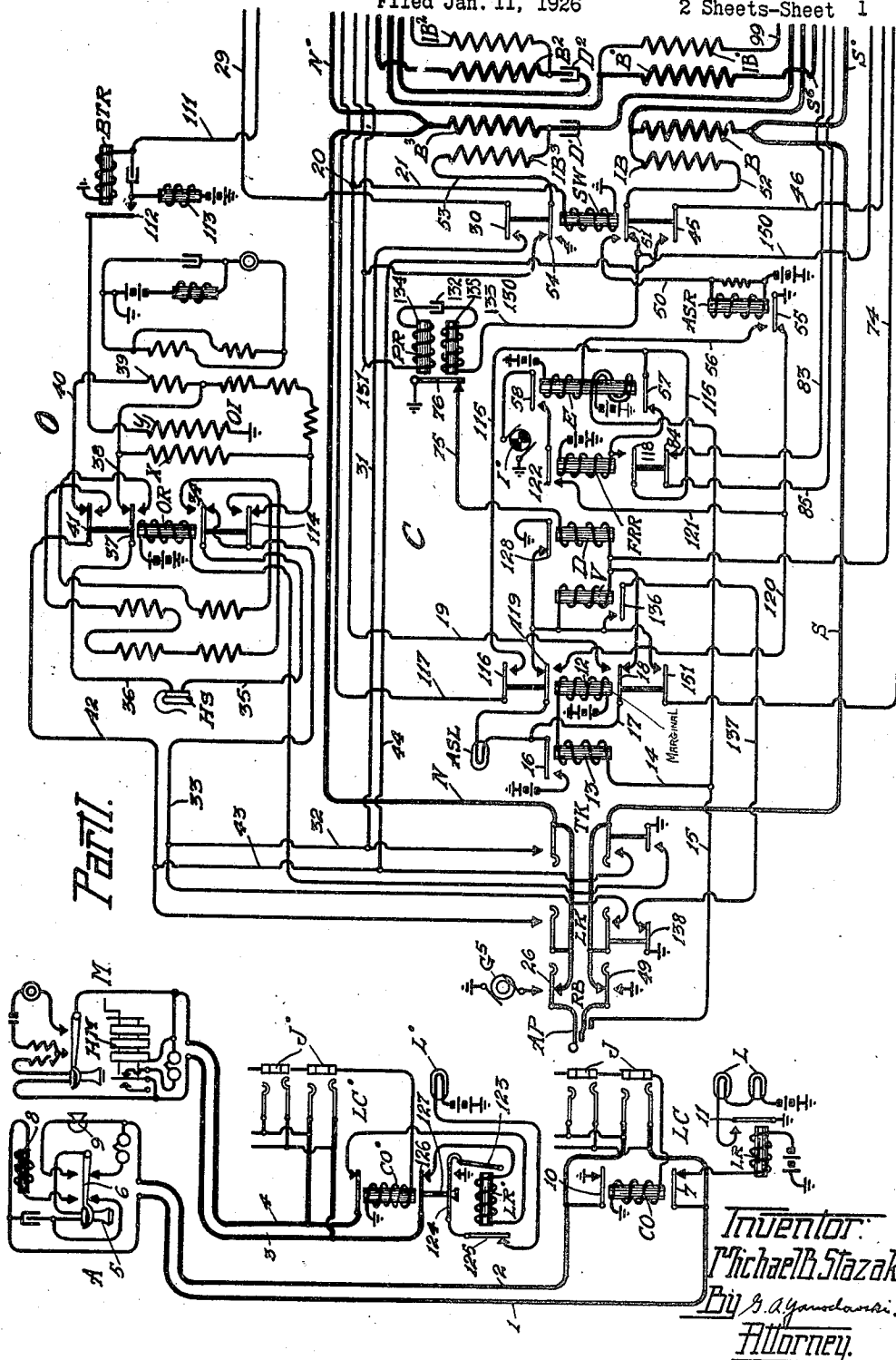
1,680,344

M. B. STAZAK

TELEPHONE SYSTEM

Filed Jan. 11, 1926

2 Sheets-Sheet 1



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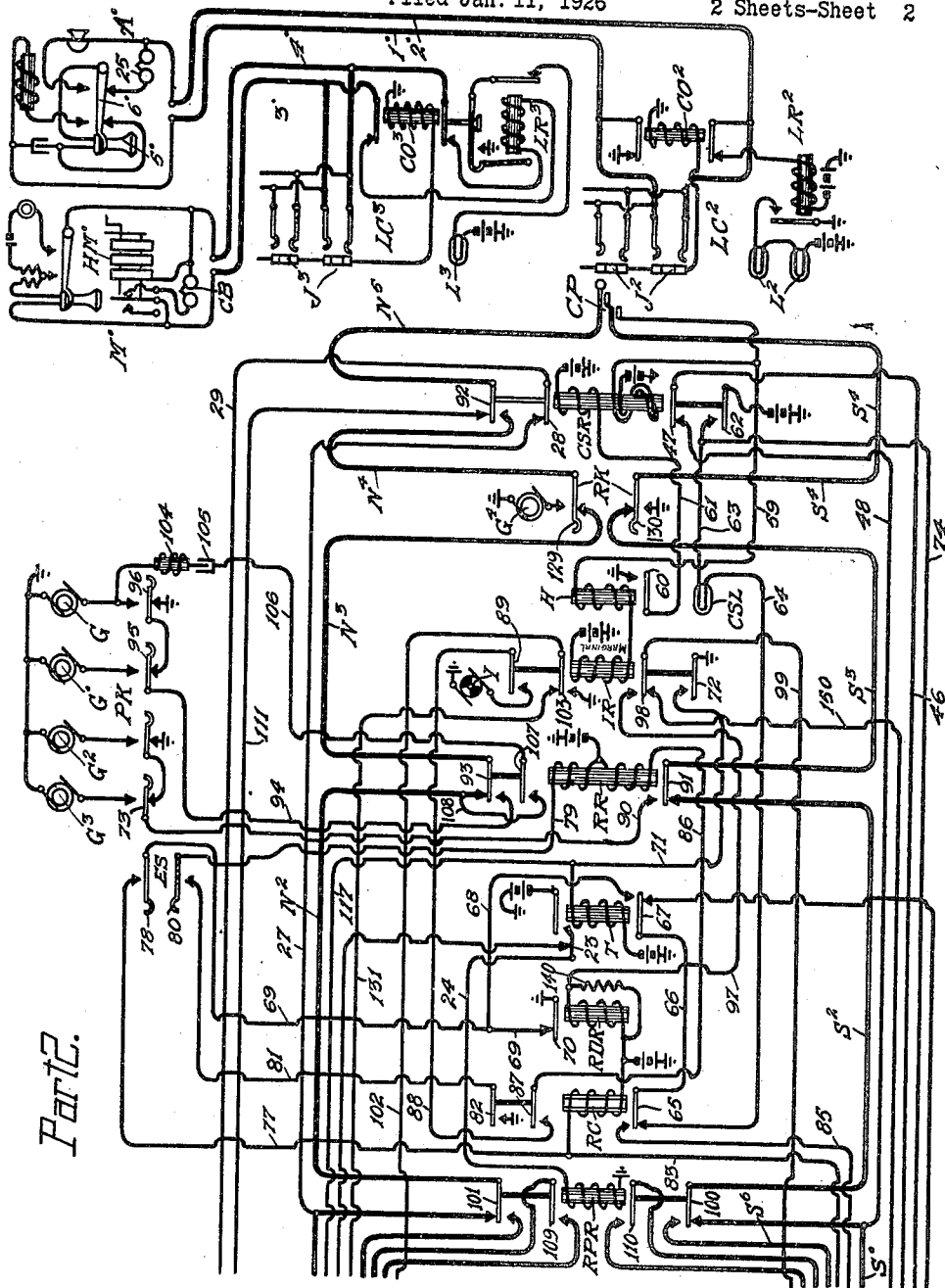
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TELEPHONE SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed January 11, 1926. Serial No. 80,438.

My invention relates to a telephone system to connect subscriber's lines by means of a manual or semi-automatically operated connecting circuit, and is adapted to be used in exchanges which interconnect both magneto and common battery subscribers' lines. A large number of exchanges are located in towns or cities having common battery local lines. These exchanges often have country subscribers who have magneto telephone lines, and as the toll or country subscribers often wish to converse with local or town subscribers, it is necessary to have a cord circuit which may be used to interconnect the two kinds of lines. The present invention provides a high impedance, full universal cord circuit arranged for flashing recall, automatic ringing, keyless listening on common battery connections, and means to cut out the repeating coils on a through magneto line connection.

The object of the present invention is to provide a system of the above character which is devised to complete connections from a subscriber having a magneto type substation to another magneto type substation, or to a common battery type substation or from a subscriber having a common battery type substation to another common battery type substation or a magneto type substation.

One of the features of my invention is keyless listening on common battery connections, means being provided whereby the operator's circuit is automatically connected to the calling subscriber's line to permit the operator to converse with the subscriber. But when a subscriber having a magneto type substation initiates a call the above noted listening means are not actuated and it is necessary for the operator to throw her listening key before a conversational circuit is completed from the subscriber to the operator.

Another feature is the provision of a circuit having both automatically and manually operated means for calling the subscriber wanted. If the called subscriber is provided with a common battery substation the automatic harmonic ringing means may be employed and the ringer at the substation will be actuated intermittently until the subscriber answers or the calling subscriber abandons the call and replaces his receiver upon its switchhook. If the called sub-

scriber has a magneto type substation, it is necessary for the operator to actuate her ringing key every time she wishes to actuate the ringer of the substation wanted. Means are also provided whereby the automatic ringing apparatus is returned to normal when the called subscriber removes his receiver from its switchhook to answer a call.

Still another feature is the provision of means whereby the calling subscriber may abandon a call and stop the automatic ringing means from functioning by replacing his receiver upon its switchhook.

Another feature is the provision of means whereby when a call is extended from a magneto type substation to another magneto type substation the repeating coils, which are used in making the connection between common battery type substations, are removed from the circuit.

The above features, as well as others, will be more clearly pointed out in the ensuing specification and appended claims. For a better understanding of the same reference may be had to the accompanying drawings which, when placed together with part 2 to the right of part 1, and with the lines of part 1 continued in the corresponding lines of part 2, illustrate one complete circuit.

At the extreme left of part 1 two subscribers' substations A and M are shown, A being of the common battery type and M of the magneto type. The substation A is connected to a line circuit LC at the central office by a pair of lines 1 and 2 connected in multiple to a number of jacks J which appear at a number of operators' positions. A line relay LR is adapted to close a circuit for a number of lamps L which are associated with the jacks J. This is the usual system employed to enable a plurality of operators to be notified of an incoming call. A cut off relay CO is also provided which when actuated will deenergize the line relay LR.

The magneto type substation M is connected by a pair of lines 3 and 4 to the main exchange where it terminates in a line circuit LC' which has multiple jacks J' and lamps L' similar to the jacks J and lamps L of the line circuit LC. A line relay LR' and a cut off relay CO' are also provided.

The cord circuit C is provided to extend a connection from the substations A and M to the substations A' and M', part 2, which

are similar in every detail to the substations A and M and terminate at the main exchange in line circuits LC² and LC³. The cord circuit C has an answering plug AP and a calling plug CP, a ringback key RB, a ringing key RK, and a four party key PK.

The ringback key RB is provided to ringback on a calling subscriber's line. The ringing key RK is adapted to connect generator G⁴ to the line to actuate the call bell when a connection is extended to a magneto type substation. The four party key PK is associated with four ringing generators G, G', G² and G³, which provide harmonic ringing current. An interrupter I intermittently connects the ringing current to the called subscriber's line by alternately closing and opening a circuit for a ringing relay RR over a circuit maintained by a ringing control relay RC. A repeating coil is composed of four windings B, B', B² and B³ and has two condensers D' and D² interposed between the coils.

A detailed description of the completion of a call from a common battery type substation to another common battery substation will now be given:

When the subscriber at the substation A removes his receiver 5 from the switchhook 6 a circuit is completed for the line relay LR traced from battery, through relay LR, closed contact 7 of relay CO, line 1, inductance 8, closed switchhook contacts, transmitter 9, line 2, closed contact 10 of relay CO to ground. Relay LR, upon energization, attracts its armature 11 to complete a circuit for the line lamps L traced from battery through the lamps L, and closed contact 11 to ground. The lamps L which are located at different operator's positions are lighted to indicate that a subscriber is calling. One of the answering operators will now insert into one of the jacks J an answering plug, such as the plug AP of the cord C illustrated. When the plug AP is inserted into the Jack J, a circuit is completed for the cut off relay CO and the relays 12 and 13 traced from battery, through relays 12 and 13, conductors 14 and 15, sleeve contacts of the plug AP and jack J, to ground through the cut off relay CO. Relay CO thereupon attracts its armatures 7 and 10 which break the energizing circuit for relay LR whereupon its armature 11 is returned to normal; thus interrupting the circuit for the lamps L. The relays 12 and 13 are energized and attract their armatures thus completing a circuit traced from battery, through closed contact 16 of relay 13, conductor 17, alternate contact 18 of relay 12, conductor 19 to point 20 where the current divides part of it flowing through conductor 21 and switching relay SW to ground; the other part flowing through conductor 19 to make before break contact 23, conductor 24 and repeating coil

relay RPR to ground. Relays SW and RPR are thus energized. Upon the energization of relay SW, the operator's circuit O is connected to the subscriber's station A over the following circuit. Transmitter 9, line 2, tip contacts of the connected jack and plug, closed contact 26 of the ringback key RB, thence over the heavy conductors N and N', conductor 27, closed contact 28 of relay CSR, conductor 29, closed contact 30 of relay SW, conductors 31, 32 and 33, normal contact 34 of operator's relay OR, conductor 35, head set HS, conductor 36, normal contact 37, conductor 38, winding 39 of the operator's induction coil OI, conductor 40, normal contact 41, conductors 42, 43, and 44, closed contact 45 of relay SW, conductor 46, normal contact 47, conductor 48, heavy conductor S', normal contact 49 of ringback key RB, ring contacts of the connected plug and jack, line 1, induction coil 8 and back to transmitter 9. The battery current for this talking circuit is supplied by a circuit traced from battery, relay ASR, conductor 50, alternate contact 51 of relay SW, conductor 52, winding IB of the resistance coil associated with the repeating coil, repeating coil winding B, then over the above described circuit through the subscriber's loop, repeating coil B³, resistance coil IB³, conductor 53, to ground through alternate contact 54 of relay SW. The relay ASR is energized over this circuit and attracts its armature 55 which closes a circuit for relay E, traced from battery, through the relay E, conductor 56, to ground at alternate contact 55 of relay ASR. The relay E thereupon attracts its armatures 57 and 58, but no action is caused at this time by the energization of relay E.

The operator having ascertained the number of the subscriber wanted takes the calling plug CP associated with the plug AP and makes the busy test in the usual manner. Assume that the wanted subscriber is the one marked A' on the drawing and that the line is idle. The operator will insert the plug CP into a jack J² associated with the substation A' completing a circuit traced from battery, interrupter relay IR, relay H, conductor 59, sleeve contacts of the connected plug and jack to ground through relay CO². The relays CO², and H and IR are all energized. Relay CO² attracts its armatures to prevent the line relay LR² traced from operating when the subscriber at A' answers the call. Relay IR closes a circuit from battery, through relay T, conductor 71 to ground at closed contact 72 of relay IR; thus energizing relay T. Relay H attracts its armature 60; which completes a circuit for the calling supervisory relay CSR traced from battery, through relay CSR and conductor 61 to ground through closed contact 60 of relay H. Relay CSR energizes and

attracts its armatures thus disconnecting the operator's set from the calling line by opening contacts 28 and 47. The closing of contact 62 completes a circuit for the calling
 5 supervisory lamp CSL traced from battery, closed contact 62, conductor 63, calling supervisory lamp CSL, conductor 64, normal contact 65 of relay RC, conductor 66, alternate contact 67 of relay T, conductors 68
 10 and 69 to ground at normal contact 70 of the ringing disconnect relay RDR. A circuit is also established for relay D which is energized by current flowing from battery, closed contact 62, conductor 74, relay D, conductor
 15 75 to ground at normal contact 76 of the polarized relay, PR.

The operator next presses the proper
 plunger of the party ringing key PK to transmit ringing current to the call bell at
 20 the substation A'. Assuming that generator G³ is of the proper frequency to actuate the call bell, the operator will actuate plunger 73 which will remain actuated after the pressure is released from it. The end
 25 springs ES are momentarily actuated when the plunger 73 is depressed and complete the following circuit for the ringing control relay RC. Battery, relay RC, conductor 77, actuated end spring 78, conductor 69, to
 30 ground at normal contact 70 of relay RDR. The ringing relay RR is momentarily energized to give an instantaneous or preliminary ring to the wanted subscriber. Relay RR is momentarily operated by current
 35 flowing from battery, relay RR, conductor 79, end spring 80 which is closed, conductor 81 to ground at closed contact 82 of relay RC which is locked up by current flowing from battery, through the winding of relay
 40 RC, conductor 83, normal contact 84 of the flashing recall relay FRR, conductor 85, alternate contact 65 of relay RC, conductor 66, alternate contact 67, conductors 68 and 69, to ground at normal contact 70.

The attraction of contact 65 by relay RC interrupts the circuit for the calling supervisory lamp CSL which is thereupon effaced. When the relay T was energized a new holding circuit was completed for the repeating
 50 coil relay RPR which is maintained by current flowing from battery, through the closed contact 23, conductor 24 and relay RPR to ground. Upon the energization of relay RC a circuit is completed for the ringing relay RR traced from battery, through
 55 the lower winding of relay RR, conductor 86, closed contact 87 of relay RC, conductor 88, closed contact 89 of relay IR to ground through the constantly rotating interrupter I. This circuit is alternately completed and interrupted by the interrupter I as long as relay RC remains energized and consequently the ringing relay RR is intermittently energized and attracts its armatures
 60 to connect ringing current to the called sub-

scriber's line over the following circuit. From ground, through the ringing generator G³, plunger 73, conductor 90, alternate contact 91, over the heavy conductor S³, through the closed contact of the ringing
 70 key RK, conductor S⁴, ring contacts of the connected plug and jack, out over the line 2' through the call bell 25 at the subscriber's substation, back over the line 1' through the tip contacts of the connected plug and jack,
 75 alternate contact 92, normal contact 129 of the key RK, alternate contact 93 of relay RR, conductor 94, and plungers 95 and 96 to ground. The ringing current is intermittently connected to the subscriber's line until
 80 the called subscriber answers the call, or the calling subscriber abandons the call. When the called subscriber removes the receiver 5' from the switchhook 6' a circuit is established for the ringing disconnect relay RDR
 85 traced from battery, relay RDR, conductor 97, alternate contact 98, conductor 99, windings IB' and B', conductor S⁶, alternate contact 100, normal contact 91 of relay RR, which is alternately energized or deenergized, closed ringing key contacts RK, ring
 90 contacts of the connected plug and jack, out over line conductor 1' through the closed switchhook contacts at the substation, back over line conductor 2', through the tip contacts
 95 of the connected plug and jack, alternate contact 92, normal ringing key contacts, normal contact 93, alternate contact 101, through winding B² of the repeating coil, resistance coil winding IB², conductor
 100 102, to ground at alternate contact 103 of relay IR. The relay RDR remains energized as long as the called subscriber's receiver is off its switchhook. Upon the energization of relay RDR the relay RC has
 105 its locking circuit broken at contact 70 and returns to normal. This breaks the circuit for the ringing relay RR which returns to normal.

Each time the ringing relay RR is energized, to transmit ringing current to the
 110 called line, the calling subscriber receives an audible ringing signal over a circuit traced from ground, through generator G, coil 104, condenser 105, conductor 106, alternate
 115 contact 107, conductor 108, alternate contact 101, coil B², winding IB², conductor 102 to ground at contact 103 of relay IR. This current in coil B² sets up a current in coil B³ which passes over the heavy conductors
 120 to the subscriber's station A where the induced current causes a vibratory action in the receiver 5 and thus notifies the calling subscriber that the called subscriber is being signaled. A talking circuit now exists between
 125 the calling and called substations over a circuit formed by the heavy conductors, the repeating coils, B, B', B², and B³, and the condensers D' and D². This circuit is closed at alternate contacts 109 and 110 of
 130

the repeating coil relay RPR which is maintained in an energized position by a circuit including the contact 23 of relay T which remains energized as long as the plug CP is in the jack J².

Assuming now that the called line was busy, when the operator tested the line by touching the tip contact of the plug CP to the sleeve contact of the jack J², battery potential will be on the sleeve contact of the jack. This battery potential will be caused by current flowing through relays IR and H of another cord circuit C connected to a multiple jack of the called line. A circuit for the busy test relay BTR will be completed traced from battery on sleeve contact of the jack, tip contact of plug CP, normal contact 92, conductor 111 to ground through relay BTR. Relay BTR attracts its armature 112 to complete a circuit traced from battery through inductance 113, armature 112 and through the winding y of the operator's induction coil OI to ground. The current passing through the winding Y induces current in the winding X of the coil OI which flows through normal contact 37, conductor 36, head set HS, conductor 35, normal contacts 34 and 114 back to the other side of the winding X. This produces a characteristic click in the head set HS which is the recognized busy signal. Upon receiving this busy signal, the operator will inform the calling subscriber that the wanted line is busy and he will replace his receiver upon its switchhook to return the apparatus in the cord circuit to normal in a manner hereinafter described.

If the called subscriber does not respond when the call bell is actuated, the calling subscriber may at any time abandon the call by replacing his receiver upon its switchhook. When the receiver is replaced the circuit for relay ASR is interrupted at the switchhook contacts and contact 55 returns to normal interrupting the holding circuit for relay E. The return of contact 57 of relay E to normal completes an energizing circuit for flashing recall relay FRR traced from battery through relay FRR, normal contact 57, conductor 115, alternate contact 116, conductor 117 and contact 72 of relay IR to ground. When relay FRR attracts its armature 118 it establishes a locking circuit for itself traced from battery, through the relay, its contact 118, conductor 115 and contact 72 to ground, as previously described. The attraction of armature 84 opens the locking circuit for the ringing control relay RC which returns to normal and disconnects the ringing current from the called line. When the contact 55 of relay ASR returned to normal it closed a circuit for the answering supervisory lamp ASL which was illuminated by current flowing from battery through closed contact 16,

lamp ASL, alternate contact 119 of relay 12, conductor 120 and contact 55 to ground. When the operator notices the lamp ASL glowing she will know that the calling subscriber has abandoned the call and she will then withdraw the plugs AP and CP from the jacks J and J² and all the apparatus will return to normal as hereinafter described.

When the conversation has been finished the subscribers replace their receivers and disconnection takes place in the following manner: When the calling subscriber replaces his receiver the circuit for relay ASR is interrupted and the said relay returns to normal and causes the following action: The relay E deenergizes, the relay FRR is energized and the lamp ASL is lighted to inform the operator of the disconnection of the calling subscriber, all as previously described.

When the called subscriber replaces his receiver the circuit for relay RDR is broken at the switchhook contacts and it returns to normal. Its contact 70 completes a circuit for the calling supervisory lamp CSL which is thereupon illuminated by current flowing from battery, closed contact 62, conductor 63, lamp CSL, conductor 64, normal contact 65, conductor 66, alternate contact 67, conductors 68 and 69 to ground at normal contact 70. Both the lamps ASL and CSL being now lit, the operator will know the conversation has been completed and will withdraw the plugs AP and CP from the jacks J and J². When AP is withdrawn the circuits of relays CO, 12 and 13 are broken and they return to normal, causing the deenergization of relays FRR and SW. When the plug CP is withdrawn the circuit for relays CO², H and IR is broken. Relay IR returns to normal and at its contact 72 interrupts the circuit for relay T which returns to normal and opens the circuit of relay RPR at contact 23. Relay H returning to normal opens the circuit for relay CSR which breaks the circuit for relay D at contact 62. The apparatus used to complete the call is now all at normal and ready for another call. The lower windings of the relay E and CSR are non-inductively wound so as to drain the relays 12 and 13 and IR and H when the plugs AP and CP are removed from the respective jacks to prevent the operator from receiving a disagreeable shock should she accidentally grasp the sleeve of either plug when removing them from their respective jacks.

If, after the completion of a call and before the plugs have been withdrawn from their respective jacks, the calling subscriber desires to make a recall he will again remove his receiver from its switchhook which will cause the answering supervisory lamp ASL to flash which will inform the operator that

the subscriber desires to make another call. This is accomplished in the following manner:

When the upper contacts of switchhook 6 are closed a circuit for the relay ASR is again completed through the subscriber's loop as before described. Relay ASR is energized and attracts its armature 55 which closes an energizing circuit for the relay E which closes its contact 58 to establish a circuit for the lamp ASL over a circuit traced from battery, lamp ASL, alternate contact 119, conductors 120 and 121, alternate contact 122 of relay FRR, alternate contact 58 and through the constantly rotating interrupter I' to ground. The circuit for the lamp ASL is intermittently interrupted by the interrupter I' which causes the lamp ASL to flash. The operator recognizes this as a recall signal whereupon she will withdraw the calling plug CP to deenergize relays IR and H which in turn deenergize relay CSR. When the contacts 28 and 47 return to normal, the operator will again be connected in a conversational circuit with the calling subscriber and can inquire as to his wants. It will be remembered that the relays 12, 13 and FRR were energized during the preceding call and have not been returned to normal because the operator had not withdrawn the answering plug.

The cord circuit C may also be used to complete calls between subscribers' lines having magneto type substations. Assume that the subscriber at M desires to converse with the subscriber at M'. The subscriber at M will operate his hand generator HM which will cause the energization of line relay LR' in the usual manner. Relay LR' attracts its armatures 123 and 125. The attraction of armature 123 allows the spring 124 to drop down and as the relay LR' is deenergized when the hand generator HM is no longer actuated the contact 125 returns to normal. Contact 123 is prevented from returning to normal by the construction of the spring 124. A circuit for the lamp L' is now completed and the same is actuated by current flowing from battery, lamp L', normal contact 125 to ground at spring 124. Upon noticing the glowing lamp L' an operator will insert a plug AP into one of the multiple jacks J' associated with the lamp L'. A circuit is now completed for current flowing from battery through relays 12 and 13, conductors 14 and 15, tip contacts of AP and J' to ground at relay CO'. The relay 12 is not energized at this time because of the high resistance of the cut-off relay CO'. When CO' is energized it attracts its armature 126 which is connected to spring 124 by a shaft 127. The spring 124 is raised and the contact 123 returns to normal. The lamp L' is effaced due to the interruption of its energizing circuit at spring 124. The operator then actuates her talking key TK

and listening key LK to learn the wants of the calling subscriber.

Upon obtaining the information that the wanted subscriber is the one at substation M', she will make the busy test and if the line is idle, insert the calling plug CP into the proper jack J³ whereupon a circuit is completed for current flowing from battery, through relays IR and H, conductor 59, sleeve contacts of CP and J³ and through relay CO³ to ground. Relay IR is not energized because of the high resistance of relay CO³. Relay H attracts its armature 60 and closes an energizing circuit for relay CSR traced from battery through relay CSR, conductor 61 to ground at alternate contact 60. Relay CSR completes a circuit for relay D traced from battery through closed contact 62, conductor 74, relay D, conductor 75, to ground at normal contact 76. The attraction of armature 128 of relay D opens the energizing circuit for the lamp ASL which was lighted when relay 13 was energized. The said lamp ASL was illuminated by current flowing from battery through contact 16, lamp ASL, normal contact 119 and normal contact 128 to ground.

The operator will next actuate her ringing key RK to connect ringing current to the called line to actuate the call bell at substation M'. The substation called may be equipped for harmonic ringing and if such is the case the operator will actuate the proper plunger of the ringing key PK and ringing current will be transmitted to the called line over a path previously described. However, it will be necessary for the operator to actuate the plunger for every impulse of current transmitted, as in such a connection the automatic ringing means are not used. The circuit within the cord over which this ringing current is supplied is the same as that previously described. Assuming that the called substation M is equipped with straight line ringing, the actuation of the ringing key RK will transmit ringing current over a circuit traced from ground through the ringing generator G⁴, actuated contact 129 of key RK, alternate contact 92, tip contacts of CP and J³, line 3', through the hand generator contacts, call bell CB, line 4', ring contacts of J³ and CP, to ground at alternate contact 130 of key RK. As soon as the called subscriber removes his receiver from its switchhook and the operator releases her ringing key RK the subscribers at M and M' are in a conversational circuit traced from M, line 4, tip contacts of J² and AP, conductors N and N', normal contact 101, conductor N², normal contact 93, conductor N³, normal contact 129, conductor N⁴, alternate contact 92, conductor N⁵, tip contacts of CP and J³ out over the line 3', through the substation M', and back over line 4', ring contacts of J³ and CP, conduc-

tor S⁴, normal contact 130, conductor S³, normal contact 91, conductor S², normal contact 100, conductors S' and S, ring contacts of AP and J', line 3 and substitution M. It will be seen that in this connection the repeating coils are not used but are cut out of the circuit. In a connection between a pair of magneto subscribers, the operator may ask the calling subscriber to replace his receiver and inform the subscriber thereof that she will call him when the call is completed. If such is the case, to re-signal the subscriber, the operator will actuate her ring back key RB to connect ringing current from the generator G⁵ to actuate the call bell at the calling substitution M which is equipped with straight line ringing.

Upon the disconnection of a connection between two magneto lines only one lamp, the answering supervisory lamp ASL, is actuated and when the operator notices that the lamp ASL is glowing she will withdraw the connecting plugs and the apparatus will return to normal. When the subscribers at M and M' finish their conversation, they will replace their receivers and actuate their hand generators HM and HM' to "ring off". An energizing circuit for the polarized relay PR is completed and it is actuated by current flowing from one contact of hand generator HM', line 3', tip contacts of J³ and CP, conductor N⁵, alternate contact 92, conductors N⁴, N³, N² and N', windings B³ and IB³, conductor 53, normal contact 54, conductors 130 and 131, winding 134, condenser 132, winding 135, conductor 133, normal contact 51, conductor 52, windings IB and B, conductors S', S², S³, and S⁴, ring contacts of CP and J³, line 4' and to the other contact of the generator HM'. When the hand generator HM is operated an energizing circuit is completed for the relay PR which is actuated by current flowing from one contact of HM, line 4, tip contacts of J' and AP, conductor N to winding B³ and then over the previously described path to winding B then back over conductor S, ring contacts of AP and J', line 3 to the other contact HM. It will be seen from this that the actuation of either hand generator HM or HM' will start the operation of the disconnecting means. Relay PR is energized and attracts its armature 76 which interrupts the circuit for relay D which thereupon returns to normal and closes its contact 128 which completes an energizing circuit for relay V traced from battery, closed contact 62, conductor 74, relay V and normal contact 128 to ground. The relay V energizes and closes a locking circuit for itself traced from battery over the above mentioned path through relay V, its own contact 136, conductor 137, to ground at normal contact 138 of the listening key LK. The relay V remains energized under the control of the listening key LK to complete an energizing circuit for the lamp ASL to inform the operator that the subscribers have finished their conversation. The lamp ASL is lighted by current flowing from battery through lamp ASL, normal contact 119, closed contact 136, to ground at contact 138 of key LK. As soon as the hand generators HM or HM' are no longer operated the relay PR is again de-energized and the energizing circuit for relay D is again completed and it opens its contact 128 which interrupts the original energizing circuit of relay V. The operator seeing the lamp ASL glowing will withdraw the plugs AP and CP. The withdrawal of AP will interrupt the energizing circuit of relays CO' and 13. Relay 13 at contact 16 opens the circuit for the lamp ASL. The withdrawal of CP causes the deenergization of relays CO³ and H. Relay H opens the energizing circuit for relay CSR which opens its contact 62 and thus breaks the energizing circuit for relays V and D which return to normal. Relay V opens another point in the circuit of lamp ASL at contact 136. All the apparatus is now at normal and ready to complete another call.

The cord circuit of my invention may also be used to complete calls from a subscriber having a magneto type substitution to one having a common battery type substitution. In the completion of such a call the operation is as follows: The subscriber at M actuates his hand generator and the action is similar to that described in a magneto to magneto connection. Assuming the calling subscriber wishes to talk to the subscriber at A', the operator inserts the calling plug CP into the jack J² associated with the substitution A'. The relays CO², H and IR are energized as before described. Upon the energization of these relays, energizing circuits for the relays CSR and T are completed. Relay T operates to close an original energizing circuit for the relay RPR through its contact 23. The relay RPR attracts its armatures 109 and 110 to connect the repeating coils into the circuit. The ringing mechanism is actuated and the operation is similar to that described for a common battery to common battery substitution connection. Battery current for talking purposes is supplied to the called line from battery through relay RDR out over the line and back to ground at alternate contact 103 of relay IR. A resistance 140 tends to offer a free path for the current and thus eliminates any muffling of the voice currents. This action takes place in all connections in which the called substitution is of the common battery type.

Upon the disconnection of such a connection both the lamps ASL and CSL glow to inform the operator that the conversation has been completed. When the called sub-

scriber replaces his receiver the relay RDR is deenergized and its contact 70 completes a circuit for the lamp CSL traced from battery, contact 62, lamp CSL, normal contact 65, alternate contact 67, to ground at normal contact 70. When the calling subscriber replaces his receiver he actuates his hand generator or magneto HM. This energizes the relay PR which, at its armature 76, breaks the energizing circuit for relay D which returns to normal and at its contact 128 completes an energizing circuit for the relay V. The relay V locks itself up and establishes a circuit for the lamp ASL which is caused to glow by current flowing from battery, through lamp ASL, normal contact 119, alternate contact 136, to ground at normal contact 138 of LK. Upon noticing that both lamps are glowing the operator will withdraw the connecting plugs and the apparatus will return to normal, all as before described. The present cord circuit is also adapted to complete a call from a common battery substation to a magneto substation.

25 In such a case the action following the insertion of the plug AP in the jack of the calling subscriber's line up to the time when the operator inserts her calling plug CP into a jack J³ associated with a magneto type substation such as M', is similar to that taking place when a connection is established from one common battery line to another. Upon the insertion of the answering plug AP, the relays CO, 12, 13, SW, ASR and E are operated. When the calling plug CP is inserted into the jack J³ the relays CO³ and H are operated and cause the energization of relays CSR and D. The operator next presses the manual ringing key RK and transmits ringing current to the called subscriber as previously described.

Upon completion of the conversation the subscribers replace their receivers and the called subscriber operates his hand generator HM' to actuate the relay PR over a circuit traced from magneto, line 3', tip contact of jack and plug, conductors N⁵, N⁴, N³, and N², alternate contact 101, windings B² and IB², conductor 102, contact 103, conductor 131, relay PR, conductors 133 and 150, normal contact 98, conductor 99, windings IB' and B' conductors S', S², S³ and S⁴, ring contacts of plug and jack, and line 4' back to the magneto. The energization of relay PR deenergizes relay D which causes the relay V to operate to light the lamp CSL by current flowing from battery, contact 62, lamp CSL, contacts 65, 67, 151 and 136 to ground at contact 138 of key LK. When the calling subscriber replaced his receiver the relay ASR was deenergized and opened the circuit of relay E. Relay ASR returning its contact 55 to normal established a circuit which caused lamp ASL to glow by current flowing from battery, closed contact

16, lamp ASL, alternate contact 119, to ground at normal contact 55. The operator will then restore all the apparatus used by withdrawing the plugs AP and CP.

From the foregoing description it will be seen that the same cord circuit can be used to extend a call from a common battery substation to another common battery substation; from a common battery substation to a magneto type substation; from a magneto type substation to another magneto type substation; or from a magneto type substation to a common battery type substation.

While I have described a preferred embodiment of my invention, it is to be understood that I do not desire to be limited to the exact application as illustrated and described, but intend to cover all such changes and modifications as come within the spirit and scope of the appended claims.

Having described my invention what I desire to claim as new and secure by United States Letters Patent is:

1. A telephone system of the character described including a plurality of subscribers' lines, some of said lines having common battery substations and the remainder having magneto type substations, a cord circuit provided with answering and calling terminals for connecting any two of said lines, a set of repeating coils for said cord circuit, means associated with said answering and calling terminals effective to include said coils in or exclude them from said circuit, and a relay associated with said means being arranged to include said coils in said circuit whenever one of the connected lines is of the common battery type.

2. A telephone system of the character described including a plurality of subscribers' lines part being equipped with magneto type and others with common battery type substations, a cord circuit provided with answering and calling terminals adapted to connect any two of said lines, a set of repeating coils in said cord circuit and means associated with said answering and calling terminals and a relay controlled by said means for connecting the said coils into the conversational circuit when one of the lines is of the common battery type, but excluding said coils when both connected lines are of the magneto type.

3. A telephone system of the character described including a plurality of subscribers' lines some of which are equipped with common battery and the others with magneto type substations, a cord circuit provided with answering and calling terminals for connecting any two of said lines into a conversational circuit, a set of repeating coils and means associated with said answering and calling terminals and a relay controlled by said means operative whenever one of the connected substations is of the common bat-

tory type for causing said repeating coils to be connected in said conversational circuit, said relay not operating when both the connected substations are of the magneto type.

4. A telephone system of the character described including a calling subscriber's line of the magneto type, a called subscriber's line of the common battery type, a cord circuit provided with answering and calling terminals adapted to interconnect said lines, automatic ringing means in said cord circuit for operating the signal of the called subscriber, a set of repeating coils, and means associated with said answering and calling terminals and a relay controlled thereby for connecting said repeating coils into the conversational circuit between the said substations.

5. A telephone system of the character described including a cord circuit, a plurality of subscribers' lines, a set of repeating coils for said cord circuit and means and a relay controlled by said means arranged to include said repeating coils in the conversational circuit when one of the connected lines is of the common battery type and to exclude said repeating coils from the conversational circuit when both the connected lines have magneto type substations.

6. A telephone system of the character described including a cord circuit provided with answering and calling terminals arranged to connect a common battery type line to another common battery type line or to a magneto type line, a set of repeating coils, means associated with said answering and calling terminals and a relay controlled by said means for including said coils in the conversational circuit between said lines, a recall lamp, and means in said cord circuit whereby the calling subscriber may upon the completion of one call institute a recall by again removing his receiver from its switchhook to cause said lamp to flash.

7. A telephone system of the character described including a plurality of subscriber's lines part having common battery and part magneto type substations, a cord circuit for connecting any of said lines into a conversational circuit, a set of repeating coils, means in said cord circuit and a relay controlled by said means arranged to include said repeating coils in the conversational circuit when one of the connected lines is of the common battery type and to exclude said repeating coils from the conversational circuit when both the connected lines have magneto type substations, a pair of ringing current supply sources, one of said sources consisting of a plurality of ringing generators comprising a set adapted to supply ringing current to common battery lines exclusively, said other source comprising a single ringing generator adapted to supply ringing current to magneto type substations, means in said cord circuit operative upon the connection of said

cord circuit with a common battery substation for automatically supplying ringing current to subscriber's lines from said first ringing current supply source, and manual ringing means for supplying ringing current from the other of said pair of ringing current supply sources to subscriber's lines having magneto type substations.

8. A telephone system of the character described including a cord circuit adapted to connect subscribers' lines having either common battery or magneto type substations into a conversational circuit, a plurality of substations of each type, a set of repeating coils, means in said cord circuit and a relay controlled by said means adapted to include said coils in said conversational connection when one of the connecting lines has a common battery substation and to exclude said coils from a connection between two magneto type lines, means for automatically applying ringing current to a common battery line and manual means for connecting ringing current to a magneto type line.

9. A telephone system of the character described including a cord circuit, a calling plug and an answering plug for said cord circuit, a plurality of subscriber's lines having common battery and magneto type substations, a line jack for each of said lines, an operator's set, automatic means for connecting said operator's set to said cord circuit, said answering plug adapted to be connected to a line jack associated with a common battery line to cause said automatic means to operate to connect said operator's set to said cord circuit, and manual means adapted to connect the operator's set to the cord circuit when the answering plug is inserted into a jack associated with a magneto type line.

10. A telephone system of the character described including a cord circuit, a calling plug and an answering plug for said cord circuit, a plurality of lines some having common battery and others magneto type substations, said cord circuit being arranged to connect any two of said lines into a conversational circuit, a line jack for each of said lines, an operator's set, automatic means for connecting said operator's set to said cord circuit, said answering plug adapted to be inserted into a line jack associated with one of said common battery lines to operate said automatic means, and automatic means including a relay for disconnecting the said operator's set from the said cord circuit, said calling plug adapted to be inserted into a line jack associated with any one of the plurality lines to complete an energizing circuit for the said relay to disconnect the said operator's set from the said cord circuit.

In testimony whereof I have signed this specification.

MICHAEL B. STAZAK,