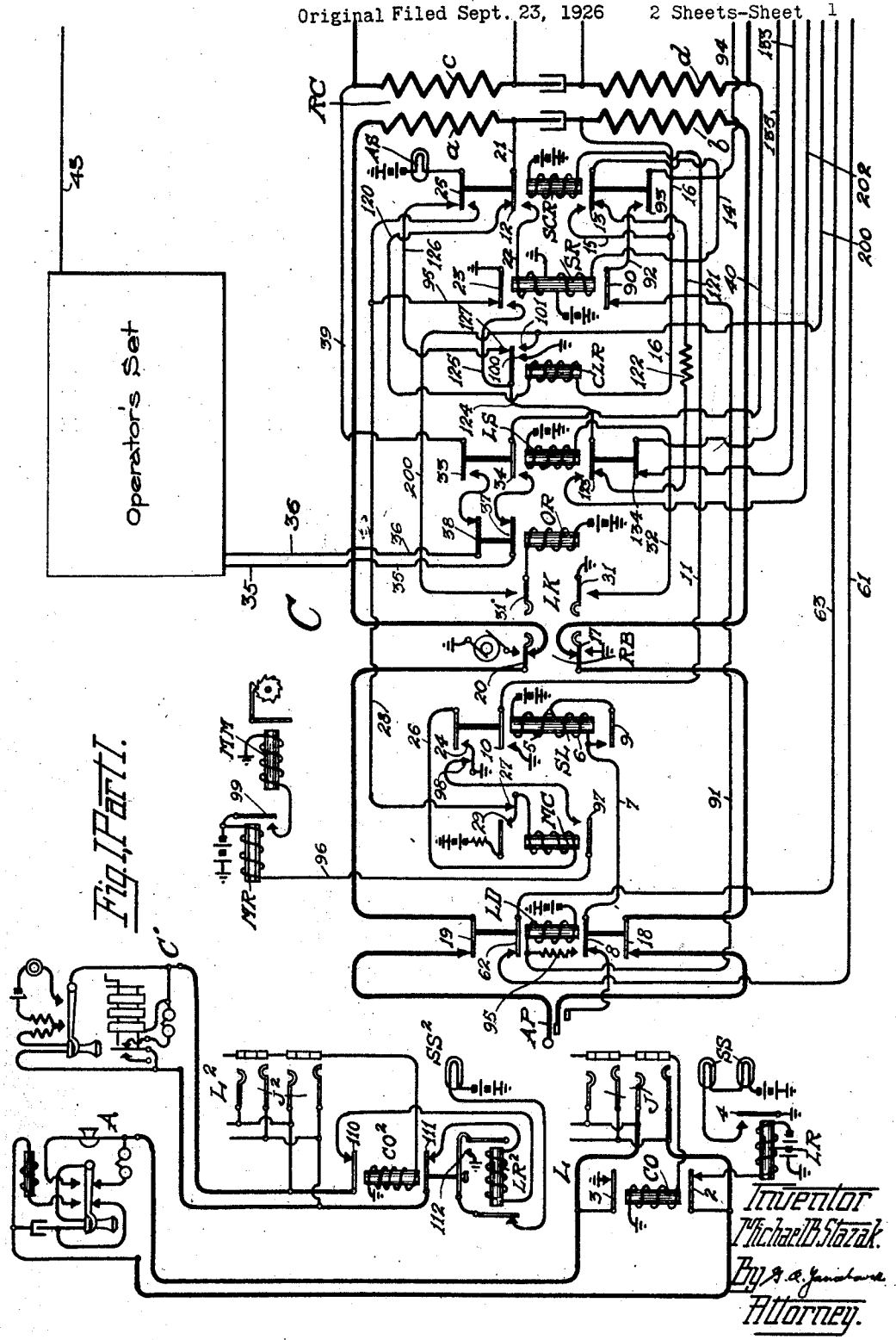
March 5, 1929. M. B. STAZAK 1,704,111

TELEPHONE SYSTEM

Original Filed Sept. 23, 1926 2 Sheets-Sheet 1



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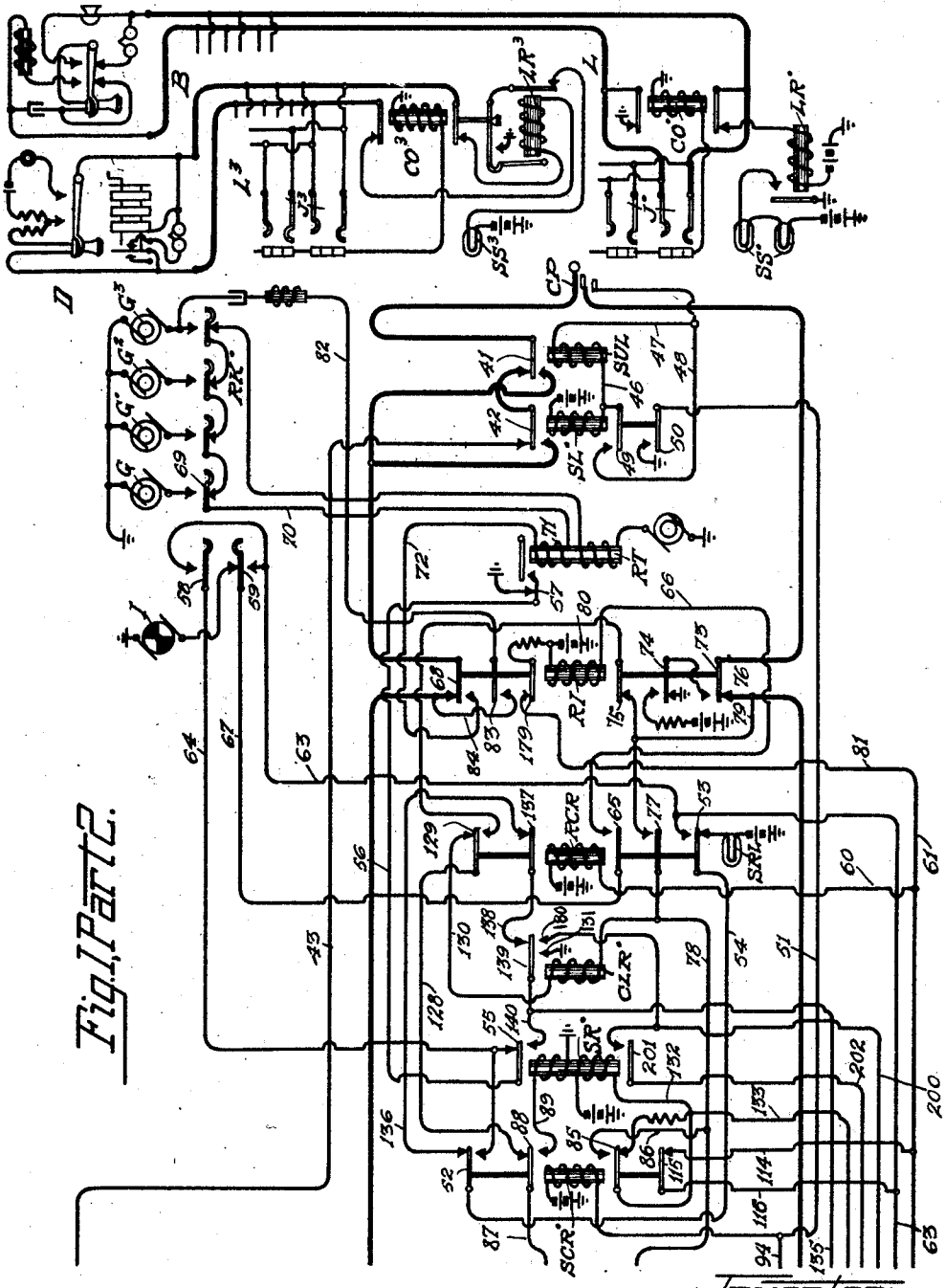

Fig. 1 Part 2.

Inventor:
Michael B. Stazak.
By M. A. Yanushonis
Attorney.

Patented Mar. 5, 1929. 1,704,111

UNITED STATES PATENT OFFICE.

MICHAEL B. STAZAK, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed September 23, 1926, Serial No. 137,179. Renewed August 6, 1928.

My invention relates to telephone systems and has to do more particularly with systems of the universal type in which universal cord circuits are provided for interconnecting telephone lines of different character such as magneto and common battery lines. The cord circuit of my invention may be used to connect a pair of common battery lines, a pair of magneto lines, a common battery line and a magneto line or a magneto line and a common battery line.

The cord circuit of my invention is provided with automatic ringing secret service and instantaneous disconnect on common battery connections, and a feature of my invention is the provision of means in the cord circuit which shunts or short circuits one half the repeating coil during the silent period, when automatically signalling a called for common battery subscriber to prevent the discharge of the condensers across the called line from giving the calling subscriber a disagreeable click in his receiver.

Another feature of my invention is the provision of novel means for providing secret service on common battery connections to prevent the operator from listening in on an established connection.

The novel features of the invention through the provision of which the above mentioned and other advantageous results are attained will be more fully explained with reference to the accompanying drawings. Referring now more particularly to Fig. 1, which comprises Parts 1 and 2, there is illustrated the universal cord circuit of my invention. By placing Part 1 to the left of Part 2 the parts thus joined illustrate the universal cord circuit for interconnecting lines of different character. To the left of Fig. 1, Part 1, I show a calling common battery substation A terminating at the exchange in the line circuit L, which comprises a line relay LR, a cut off relay CO, multiple answering jacks J and multiple line lamps SS, the said jacks J, and lamps SS appearing in a plurality of operators' positions as is well understood. A magneto subscriber's substation is also shown terminating at the exchange in a line circuit L^2 which comprises a line relay LR^2, cut off relay CO^2, multiple jacks J^2 and line lamp SS^2.

The cord circuit C is adapted for interconnecting the lines as shown and comprises an answering plug AP and a calling plug CP, the said plugs being connected by the heavily marked conductors, the said conductors having a repeating coil RC interposed and comprising windings "*a*", "*b*", "*c*", and "*d*". The answering end of the cord circuit is provided with a link disconnect relay LD, which operates when a calling common battery subscriber replaces his receiver to provide instantaneous disconnect and recall for the calling common battery subscriber. A sleeve relay SL is also provided as is also a meter control relay MC which controls the operation of the meter relay MR and meter magnet MM. A ring back key RB is provided for the usual purposes and a listening key LK controls the operation of a listening relay LS which when operated connects the operator's set O to the cord conductors. A clearing out relay CLR is provided and is actuated when the magneto subscriber signals for disconnection to control the supervisory signal AS. An operator's cut out relay OR and the relay CLR also function to provide secret service to prevent more than one operator answering the call and also prevent an operator from listening in on an established connection. A supervisory control relay SCR and a supervisory relay SR are also provided for purposes as will be more fully hereinafter described.

Referring now to Fig. 1, Part 2, I illustrate the calling end of a cord circuit C and this calling end comprises a supervisory control relay SCR′ and a supervisory relay SR′. A clearing out relay CLR′ is provided which controls the means for lighting the supervisory signal SRL when the called magneto subscriber signals for disconnection. I provide automatic ringing for signaling called common battery lines and for this purpose I provide a party line ringing key RK′ for controlling the connection of the generators G, G′, G^2 and G^3 and I also provide a ringing control relay RCR and a ringing interrupter relay RI in association with a constantly rotating interrupter I to automatically signal a called for common battery subscriber. A ring trip relay RT is also provided and is associated with the ringing current and provides means for interrupting the ringing current should the called com-

mon battery subscriber answer during a ringing period. The ringing apparatus is also used for signaling a called magneto line as will be more fully hereinafter described. A sleeve relay SL′ and an auxiliary sleeve relay SUL are also provided. To the right of Fig. 1, Part 2, I show a called common battery substation B terminating at the exchange in a line circuit L′, comprising a line relay LR′, a cut off relay CO′, multiple answering jacks J′ and the multiple line lamps SS′. I also show a called magneto substation D terminating at the exchange in a line circuit L^3, which comprises a line relay LR^3, cut off relay CO^3, multiple jacks J^3 and line signal SS^3.

Having described in general the circuit arrangement I will now describe in detail the operation of the cord circuit of my invention.

Assuming now that the common battery subscriber at the substation A initiates a call, the removal of the receiver at the substation closes an energizing circuit for the line relay LR of the line circuit L traced from battery through the winding of the relay LR, normal contact 2 of the cut off relay CO, through the closed contact of the substation switchhook to ground at normal contact 3 of the cut off relay CO. The relay LR upon energization closes its alternate contact 4 to light the multiple line lamp signals SS which appear at a plurality of operators' positions. Any one of a plurality of operators at the different positions at which the signals SS appear may answer the call to the exclusion of the others.

The operator associated with the cord C seizes the call by inserting the answering plug AP of the cord circuit C into the jack J of the calling line, establishing a circuit for the sleeve relay SL of the cord circuit C and the cut off relay CO of the line circuit L, traced from battery through the windings 5 and 6 of the sleeve relay SL, conductor 7, normal contact 8 of the link disconnect relay LD, the sleeve contacts of the connected plug AP and jack J to ground through the winding of the cut off relay CO. The sleeve relay SL upon energization closes its alternate contact 9 and a substitute circuit is established for the relay SL through its low resistance winding 5 traced from battery through the upper low resistance winding 5 of the relay SL its alternate contact 9, conductor 7 to ground through cut off relay CO over the previously described path. Cut off relay CO upon energization opens its normal contacts 2 and 3 to open the energizing circuit of the line relay LR and the line relay LR upon deenergization effaces the multiple line signals SS. The sleeve relay SL upon energization closes its alternate contact 10 establishing an energizing circuit for the supervisory control relay SCR traced from battery through the winding of the relay SCR, conductor 11 to ground at alternate contact 10 of the relay SL. The relay SCR upon energization closes its alternate contacts 12 and 13 to close an energizing circuit for the supervisory relay SR traced from battery through the lower winding of the relay SR, conductor 14, alternate contact 13 of the relay SCR, conductors 15 and 16 through the winding *b* of the repeating coil RC, normal contact 17 of the ring back key RB, normal contact 18 of the link disconnect relay LD, ring contacts of the connected plug AP and jack J through the closed contacts of the substation switchhook of the calling substation A back through the tip contacts of the jack J and plug AP, normal contact 19 of the relay LD, normal contact 20 of the ring back key RB, winding *a* of the repeating coil RC, conductor 21, alternate contact 12 of the relay SCR, conductor 22 to ground through the upper winding of the supervisory relay SR and the supervisory relay SR upon energization opens its normal contact 23 and prevents the premature lighting of the answering supervisory signal AS. The closing of alternate contacts 24 of the relay SL and 25 of the relay SCR establishes an energizing circuit for the meter control relay MC traced from ground at alternate contact 24, conductor 26 through the winding of the meter control relay MC, its normal contact 27, conductor 28 alternate contact 25 of the relay SCR through the lamp AS to battery. The relay MC is energized over this circuit but the lamp AS does not light over this circuit due to the resistance of the relay MC. The relay MC upon energization closes its alternate contact 29 establishing a locking circuit for itself traced from battery through its alternate contact 29 through the winding of the relay MC, conductor 26 to ground at alternate contact 24 of the sleeve relay SL, and the meter control relay MC controls the operation of the meter relay MR for purposes as will be more fully hereinafter described.

The energization of the relays SL, SR, SCR and MC takes place as soon as the answering plug AP is inserted into the jack of the calling line. The operator now actuates her listening key LK and the closing of alternate contact 31 of the listening key LK establishes an energizing circuit for the listening relay LS, traced from battery through the winding of the relay LS, conductor 32 to ground at alternate contact 31 of the listening key LK. The relay LS upon energizing closes its alternate contacts 33 and 34 to connect the operator's set O to the cord conductors over conductors 35 and 36, normal contacts 37 and 38 of the operator's cut out relay OR, alternate contacts 33 and

34 of the relay LS, and conductors 39 and 40 to the tip and ring conductors of the cord circuit C.

Should another operator attempt to seize the call after the operator associated with the cord circuit C is connected thereto, the low resistance path through winding 5 of the relay SL prevents the relay SL of the second cord from operating. The relay SL of the second cord failing to energize the relay SCR of the second cord remains deenergized. Current flows from battery through the relay SR of the first cord to the ring conductors of the multiple jack, into which the plug of the second cord is inserted, then through normal contact 18 of the relay LD of the second cord, normal contact 17 of the key RB, winding *b* of the repeating coil RC, conductor 16, winding of the clearing out relay CLR, normal contact 12 of the relay SCR, which relay of the second cord fails to energize due to the failure of relay SL to energize, conductor 21, winding "*a*" of the coil RC, normal contact 20 of key RB, normal contact 19 of relay LD to the tip conductors of the plug AP of the second cord and multiple jack J of the calling line to ground through the relay SR of the first cord. The relay CLR of the second cord operates over this circuit and when the operator of the second cord actuates her listening key LK the operator's cut out relay OR and the relay LS of the second cord are energized, relay OR energizing to ground at the alternate contact of the relay CLR of the second cord and relay LS energizing to ground at the key LK. The relay OR of the second cord energizes and opens its normal contacts 37 and 38 preventing the connection of the operator's set associated with the second cord to the cord conductors. The second operator failing to receive a response when she answers knows that the call has been answered by another operator and withdraws the plug of her cord from the multiple jack of the calling line which allows relay CLR to deenergize allowing relay OR to restore and the restoring of the key LK allows relay LS to restore to normal.

The operator now inquires the wants of the calling subscriber at the common battery substation A and assuming that it is the called subscriber at common battery substation B that is wanted the operator tests the called line as to its idle or busy condition by placing the tip of the calling plug CP to the sleeve of the multiple jack J′ of the called line B. If the line is busy the sleeve of the multiple jack J′ will be at a battery potential and this battery will extend from the tip of the plug CP, normal contact 41 of the auxiliary sleeve relay SUL, normal contact 42 of the sleeve relay SL′, test conductor 43 to ground through the winding of a test relay associated with the operator's set O. The energization of the test relay over this path produces the customary click in the operator's head set which indicates the busy condition of the called line.

Assuming that the called line is idle the operator inserts the calling plug CP into the multiple jack J′ of the called line establishing an energizing circuit for the sleeve relay SL′ and the auxiliary sleeve relay SUL traced from battery through the winding of the relay SL′, conductor 46, through the winding of the relay SUL, conductors 47 and 48 through the sleeve contacts of the connected plug CP and jack J′ to ground through the winding of the cut off relay CO′ of the line circuit L′ associated with the called line. Cut off relay CO, upon energization removes the substation control from the line relay LR′ of the line circuit L′. The relay SL′ upon energization closes a substitute circuit for itself traced from battery through its winding, its alternate contact 49, conductor 48, sleeve contacts of the connected plug CP and jack J′ to ground through the cut off relay CO′. The relay SUL is shunted out at alternate contact 49 of the relay SL′ and relay SUL restores. The closing of alternate contact 50 of relay SL′ establishes an energizing circuit for the supervisory control relay SCR′ traced from battery through the winding of the relay SCR′, conductor 51 to ground at alternate contact 50 of the relay SL′. The relay SCR′ upon energizing closes its alternate contact 52 thus establishing an energizing circuit for the combined supervisory and ringing lamp SRL traced from battery through the lamp SRL, normal contact 53 of the ringing control relay RCR, conductor 54, alternate contact 52 of the relay SCR′, normal contact 55 of the supervisory relay SR′, conductor 56 to ground at normal contact 57 of the ringing trip relay RT. The lamp SRL is lighted over this circuit and remains lighted until the operator depresses the ringing key R to signal the called subscriber, the lamp SRL indicating to the operator whether or not ringing current has been applied to the called line. The operator now applies the proper ringing frequency to the called line to operate the call signal at the substation B and assuming that the generator G is of the proper generator frequency for actuating the call bell at the called substation B the operator depresses the ringing key plunger associated with the ringing generator G to its fully depressed position to actuate the end spring contacts to close their alternate contacts 58 and 59. The closing of alternate contact 59 of the end springs closes an energizing circuit for the ringing control relay RCR traced from battery through the winding of the ringing control relay RCR, conductors 60 and 61, normal contact 62 of the

link disconnect relay LD, conductor 63, alternate contact 58 of the end spring contacts, conductor 64, normal contact 55 of the supervisory relay SR′, conductor 56 to ground at normal contact 57 of the relay RT. The relay RCR upon energization closes its alternate contact 53 thereby establishing a locking circuit for itself traced from battery through the winding of the relay RCR, conductors 60 and 61, normal contact 62 of the link disconnect relay LD, conductor 63, alternate contact 53 of the relay RCR, conductor 54, alternate contact 52 of the relay SCR′, normal contact 55 of the relay SCR′, conductor 56 to ground at normal contact 57 of the ringing trip relay RT. The opening of normal contact 53 of the relay RCR opens the circuit of the lamp SRL and the lamp SRL is now effaced.

The closing of the end spring contacts 58 and 59 and the energization of relay RCR now establishes an energizing circuit for the ringing interrupter relay RI traced from battery through the winding of the relay RI, conductor 66, alternate contact 65 of the ringing control relay RCR, conductor 67, alternate contacts 59 and 58 of the end spring contacts, conductor 64, normal contact 55 of the relay SR′, conductor 56, to ground at normal contact 57 of the ringing trip relay RT. The relay RI is energized over this circuit and closes its alternate contact 68 which connects ringing current from the generator G to the called line and gives the subscriber thereat an instantaneous first ring and when the pressure is released from the ringing key plunger it assumes its indicating position. The end springs 58 and 59 also assume their normal position and the closing of normal contact 59 of the end springs now connects the constantly rotating interrupter I in circuit with the ringing interrupter relay RI, traced from battery through the winding of the relay RI, conductor 66, alternate contact 65 of the relay RCR, conductor 67 to ground through the constantly rotating interrupter I and the ringing interrupter relay RI is energized and deenergized over this circuit to intermittently apply ringing current to the called line B. The ringing circuit which extends current to the called line may be traced from the generator G through alternate contact 69 of the depressed ringing key plunger, conductor 70, through the winding 71 of the ringing trip relay RT, conductor 72, alternate contact 68 of the ringing interrupter relay RI, alternate contact 42 of the relay SL′, normal contact 41 of the relay SUL, tip contacts of the connected plug CP and jack J′ through the condenser and call bell at the called substation B, back through the ring contacts of the connected jack J′ and plug CP, alternate contact 73 of the relay RI to battery and ground through alternate contact 74 of relay RI.

A circuit for short circuiting the winding "*d*" of the repeating coil RC is formed to prevent the discharge of the condensers across the called line from giving the calling subscriber at the substation A a disagreeable click in his receiver. The short circuit or shunt about the winding "*d*" of the repeating coil RC is traced from normal contact 73 of the relay RI to the point 76, conductor 79, through alternate contact 77 of the relay RCR, conductor 78 through the winding "*d*" of the repeating coil RC to point 76. The discharge of the condenser of the called line during each silent period has a tendency to momentarily energize the supervisory relay SR′ to open its normal contact 55 to open the locking circuit of the ringing control relay RCR to prematurely interrupt the ringing current to the called line, but upon each deenergization of relay RI the closure of its normal contact 179 connects battery 80 through normal contact 179 over conductor 81 in parallel with the energized ringing control relay RCR, to make the relay RCR sluggish in releasing and the said relay RCR remains energized during this momentary interruption of normal contact 55 of the supervisory relay SR′ due to the discharge of the condenser of the called line during the ringing of the called subscriber to prevent the premature interruption of the ringing current. The calling subscriber is also given a distinctive revertive ringing tone which indicates to him that the called subscriber is being signalled. This signal extends from the generator G over conductor 82 to alternate contact 83 of the relay RI, conductor 84 to the tip conductor of the cord circuit C to the calling subscriber of the substation A. The called subscriber at the substation B in response to his call signal removes his receiver from the switchhook and should the subscriber remove the same during a ringing period the combined generator and battery flow through the winding 71 of the relay RT causes the relay RT to operate and the relay RT upon energizing opens its normal contact 57 which interrupts the locking circuit of the ringing control relay RCR and the relay RCR upon deenergizing opens its alternate contact 65 which opens the circuit from the constantly rotating interrupter I to the ringing interrupter relay RI and the relay RI thus deenergizes to prevent further application of ringing current to the called line. The closing of normal contacts 68 and 73 of the relay RI now establishes an energizing circuit for the supervisory relay SR′ traced from battery through its lower winding, alternate contact 85 of relay SCR′, conductors 86 and 78 through the winding "*d*" of the repeating coil RC, normal contact 73 of relay RI and ring contacts of the connected plug CP and jack J′, through the now closed contacts

of the substation switchhook contact back through the tip contacts of the connected jack J′ and plug CP, normal contact 41 of relay SUL, alternate contact 42 of relay SL′, normal contact 68 of the ringing interrupter relay RI, through the winding "c" of the repeating coil RC, conductor 87, alternate contact 88 of relay SCR′, conductor 89 to ground through the upper winding of the relay SR′.

Should the called subscriber at the substation B remove his receiver in response to his call signal during the silent period the removal of the receiver at the substation B will bring about the energization of the supervisory relay SR′ over a path just described. Relay SR′ upon energizing opens its normal contact 55 to open the locking circuit of the ringing control relay RCR, and the ringing control relay RCR upon deenergizing opens its alternate contact 65 to disconnect the constantly rotating interrupter I from the ringing interrupter relay RI thus preventing further application of ringing current to the called line.

The subscriber at the common battery substation A and the called subscriber at the common battery substation B are now in conversational circuit, and the talking circuit may be traced over the heavily marked conductors.

Should the operator of the cord circuit C attempt to listen in on the established connection just described by actuating her listening key LK, the closure of alternate contact 31 of the key LK brings about the energization of listening relay LS. The relay LS upon energization closes its alternate contact 123 establishing an energizing circuit for the relay OR traced from battery through the relay OR, alternate contact 31′ of the key LK, conductor 200, alternate contact 201 of relay SR′, conductor 202, alternate contact 123 of relay LS, conductors 124 and 125 to ground at alternate contact 23 of relay SR. The relay OR operates over this circuit and the opening of its normal contacts 37 and 38 prevents the operator's set O from being connected to the cord conductors.

Assuming that the subscribers have finished their conversation they replace their receivers upon their respective switchhooks. The replacing of the receiver at the substation A opens the energizing circuit for the supervisory relay SR and the closing of its normal contact 90 closes an energizing circuit for the link disconnect relay LD traced from battery through the winding of the relay LD, conductor 91, normal contact 90 of the relay SR, conductor 92, alternate contact 93 of relay SCR, conductors 94 and 51 to ground at alternate contact 50 of the sleeve relay SL′. The opening of normal contact 8 of the relay LD opens the energizing circuit of the sleeve relay SL but due to the closing of alternate contact 8 of relay LD the relay SL remains energized by current flowing from battery through its upper winding 5, its alternate contact 9, conductor 7, alternate contact 8, resistance 95, conductor 91, normal contact 90 of relay SR, conductor 92, alternate contact 93 of relay SCR and conductors 94 and 51 to ground at alternate contact 50 of relay SL′. The meter control relay MC and the relay SCR remain energized as the sleeve relay SL is held up over a circuit just traced. The opening of normal contact 8 or relay LD interrupts the circuit of the cut off relay CO of the line circuit L and the relay CO restores to normal placing the line relay LR of the line circuit L again under the control of the subscriber at the substation A which permits the subscriber at the substation A to immediately recall and light the multiple line signals SS, and this recall may be answered by any operator before which the multiple line signals SS appear. The relay SR upon restoring to normal, closes its normal contact 23 which closes a circuit for the answering supervisory lamp AS traced from battery through the lamp, alternate contact 25 of relay SCR, conductors 28 and 95 to ground at normal contact 23 of the relay SR. The called subscriber at the substation B replacing his receiver upon the switchhook opens the energizing circuit of the supervisory relay SR′ at the switchhook contacts and the closing of its normal contact 55 again closes a circuit for the combined calling supervisory and ringing control lamp SRL traced from battery through the lamp to ground at normal contact 57 of the relay RT. The operator of the cord circuit C noting the two lighted supervisory lamps AS and SRL withdraws the plugs AP and CP of the cord C from the respective jacks J and J′. The withdrawal of the plug AP from the jack J of the calling line does not affect any of the apparatus of the cord circuit but when the calling plug CP is withdrawn from the jack J′ of the called line the energizing circuit of the sleeve relay SL′ is opened and the opening of alternate contact 50 of the relay SL′ opens the energizing circuit of the relay SCR′ and the relay SCR′ upon deenergization opens its alternate contact 52 to efface the signal SRL. The opening of alternate contact 50 of the relay SL′ also opens the energizing circuit of the link disconnect relay LD and the relay LD upon deenergization opens the circuit of the sleeve relay SL at alternate contact 8, and the relay SL upon denergization opens the energizing circuit of the relay SCR at alternate contact 10 of the relay SL, and the relay SCR upon deenergization opens its alternate contact 25 to efface the answering supervisory signal AS. The opening of alternate contact 24

of the relay SL opens the energizing circuit of the meter control relay MC but the relay MC is held momentarily energized after its circuit is interrupted at normal contact 24 due to its slow to release construction and the meter relay MR is now energized over a circuit just traced from battery through the winding of the relay MR, conductor 96, alternate contact 97 of the relay MC to ground at normal contact 98 of the relay SL. The meter relay upon energization closes its alternate contact 99 to close a circuit through the meter magnet MM from battery through alternate contact 99 of the relay MR to ground through the winding of the meter magnet MM. The meter magnet is energized and deenergized to operate the register associated with the meter magnet to register a call. The apparatus of the cord circuit C used in establishing a connection between the calling subscriber at the substation A and the called subscriber at substation B is now at normal, and available for use in establishing other connections.

Assuming that a call has been extended to the called substation B and the operator of the cord C has depressed the ringing plunger to connect ringing current to the called line and that the subscriber at the substation A replaces his receiver upon the switchhook before the called subscriber at the substation B has answered, the replacing of the receiver at the substation A opens the energizing circuit of the supervisory relay SR. The supervisory relay SR upon deenergizing closes its normal contact 90 to establish an energizing circuit for the link disconnect relay LD over a circuit as previously described and the relay LD upon energization opens the locking circuit of the ringing control relay RCR at its normal contact 62. The ringing control relay RCR upon deenergizing opens its alternate contact 65 to disconnect the constantly rotating interrupter from the ringing interrupter relay RI disconnecting ringing current from the called line. The closing of the normal contact 53 of the relay RCR closes a circuit through the lamp SRL over a path previously described and the closing of normal contact 23 of the relay SR also brings about the lighting of the answering supervisory lamp AS. The operator noting the two lighted signals withdraws the answering plug AP and the calling plug CP from the respective jacks and the restoration of the apparatus of the cord circuit C is the same as previously described.

Assuming that the calling subscriber at the substation A and the called subscriber at the substation B are in conversational circuit as before described and that another operator attempts to listen in: she is prevented from connecting her operator's set O to listen in on the connection. If this operator inserts the answering plug AP of another cord in the multiple jack of the calling line the battery through the lower winding of the supervisory relay SR of the cord of the established connection extends from the ring contact of the multiple jack into which the plug of the second cord has been inserted over the ring conductor of the second cord through the winding of the relay CLR of the second cord back to ground through the upper winding of the supervisory relay SR of the first cord. The relay CLR of the second cord upon energization closes its alternate contacts 100 and 101 to bring about the energization of the relay OR of the second cord when the listening key is actuated, and the opening of normal contacts 37 and 38 of the relay OR of the second cord prevents the operator's set O associated with the second cord from being connected to the established connection. Should the operator attempt to listen in on an established connection by the insertion of the calling plug of a cord pair into the multiple jacks of the established connection, the insertion will cause the relay SL′ of the second cord to operate and the operation of the relay SL′ will permit the relay CLR′ to operate from battery as before described in connection with relay CLR and the closure of alternate contacts 131 and 180 of the relay CLR′ of the second cord will bring about the operation of relay OR of the second cord when the operator actuates her listening key. The opening of normal contacts 37 and 38 of the relay OR of the second cord will thus prevent this second operator from listening in on an established connection.

Assuming now that the magneto subscriber at the substation C′ initiates a call the subscriber thereat operates the hand generator and current from the hand generator thereat operates the line relay LR^2 through normal contacts 110 and 111 of the cut off relay CO^2. The line relay LR^2 is momentarily energized by current from the hand generator to close its alternate contact 112 thus establishing a circuit for the line signal SS^2. The alternate contact 112 of line relay LR^2 is locked in its off normal position to maintain the line signal SS^2 lighted and the operator in response to line signal SS^2 inserts the answering plug AP of the cord circuit C into the jack J^2 of the calling line, closing an energizing circuit for the cut off relay CO^2 of the line circuit L^2 associated with the calling magneto substation C′, over a circuit traced from battery through the windings 5 and 6 of the sleeve relay SL, conductor 7, normal contact 8 of the link disconnect relay LD, the sleeve contact of the connected plug AP and jack J^2 to ground through the cut off relay CO^2. The cut off relay CO^2 is energized over this circuit but

the sleeve relay SL of the cord C does not energize due to the high resistance of the cut off relay CO^2. The relay CO^2 upon energization unlatches the locked alternate contact 112 of the line relay LR^2 and the opening of alternate contact 112 of the line relay LR^2 effaces the line signal SS^2.

The operator now actuates the listening key LK which brings about the energization of the listening relay LS of the cord C by current flowing from battery through the winding of the relay LS, conductor 32 to ground at alternate contact 31, of the listening key LK, and the closure of the alternate contacts 33 and 34 of the relay LS connects the operator's set O to the cord conductors. The operator now inquires the wants of the calling subscriber at the magneto substation C and assuming that it is the magneto substation D that is wanted the operator tests the line as to its idle or busy condition. Assuming that the line is idle the operator inserts the calling plug CP into the jack J^3 of the wanted line closing an energizing circuit for the cut off relay CO^3 associated with the line circuit L^3 and the auxiliary sleeve relay SUL traced from battery through the winding of the relay SL′, conductor 46, through the winding of the relay SUL, conductors 47 and 48, the sleeve contacts of the connected plug CP and jack J^3 to ground through the cut off relay CO^3. The cut off relay CO^3 and the relay SUL are energized over this circuit but the relay SL′ remains at normal.

The operator now applies the proper ringing frequency to the called line to operate the call signal at the substation B, and assuming that the generator G is the proper generator frequency for actuating the call bell at the called substation D the operator depresses the ringing key plunger associated with the ringing generator G to its fully depressed position to actuate the end spring contacts. The closing of alternate contact 58 of the end spring closes an energizing circuit for the ringing control relay RCR traced from battery through the winding of the relay RCR, conductors 60 and 61, conductor 114, normal contact 115 of relay SCR′, conductors 116 and 63, alternate contact 58 of the end spring contacts, conductor 64, normal contact 55 of the relay SR′, conductor 56 to ground at normal contact 57 of the ringing trip relay RT. The closure of alternate contact 65 of the relay RCR establishes an energizing circuit for the ringing interrupter relay RI traced from battery through the ringing interrupter relay RI, conductor 66, alternate contact 65 of the relay RCR, conductor 67, alternate contacts 59 and 58 of the end spring contacts, conductor 64, normal contact 55 of supervisory relay SR′, conductor 56 to ground at normal contact 57 of the ringing trip relay RT. Ringing current is connected to the called line due to the energization of ringing interrupter relay RI, the path for ringing current being traced from generator G, through alternate contact 69 of the depressed ringing key plunger, conductor 70, through the winding 71 of the relay RT, conductor 72, alternate contact 68 of the ringing interrupter relay RI, alternate contact 41 of the relay SUL, tip contacts of the connected plug CP and jack J^3, through the call bell at the called substation D back through the ring contacts of the connected jack J^3 and plug CP, alternate contacts 73 and 74 of relay RI to battery and ground. Ringing current is thus connected to the called substation D and as long as the ringing key plunger is held in its fully depressed position ringing current is applied to the called line. When the ringing key plunger which connects the ringing generator G is released it moves to its indicating position allowing the end spring contacts to assume their normal position and the opening of alternate contact 58 of the end spring contacts allows the relay RCR to deenergize and the relay RCR upon deenergization opens its alternate contact 65 to open the energizing circuit of the ringing interrupter relay RI. Each time that the operator applies ringing current to the called line the key plunger associated with the generator G is depressed to its fully actuated position in which position the end spring contacts are again closed to operate the ringing control relay RCR and ringing interrupter relay RI to impress ringing current upon the called line. The operator supervises the magneto connection by actuating her listening key from time to time and when the called subscriber at the magneto substation D answers further depression of the ringing key plunger associated with the generator G is stopped. The calling magneto subscriber C′ and the called magneto subscriber D are now in conversational circuit the talking circuit being traced over the heavily marked conductors.

Assuming that the subscriber at the magneto substations C′ and D have finished their conversation they replace their receivers upon their respective switchhooks and to give the operator at the cord C a disconnect signal the magneto subscriber at the substation C′ actuates his hand generator and the current from the hand generator extends from the tip of the jack J^2 and plug AP, through normal contact 19 of the relay LD, normal contact 20 of the ring back key RB, through the winding "*a*" of the repeating coil RC, conductor 21, normal contact 12 of relay SCR, conductor 120, through the winding of the relay CLR, conductor 16, winding "*b*" of the repeating coil RC, normal contact 17 of the ring back key RB, normal contact 18 of the link disconnect

relay LD, the ring contacts of the connected plug AP and jack J^2 to the hand generator at the substation C'. The relay CLR energizes over this circuit and establishes an energizing circuit for the supervisory relay SR traced from battery through the lower winding of the relay SR, conductor 14, normal contact 13 of relay SCR, conductor 121 through the resistance 122, normal contact 123 of the listening relay LS, conductor 124 to ground at alternate contact 100 of the relay CLR. The relay SR upon energizing closes its alternate contact 23 to establish a locking circuit for itself traced from battery through the lower winding of the relay SR, conductor 14, normal contact 13 of relay SCR, conductor 121, resistance 122, normal contact 123 of the relay LS, conductor 124, conductor 125 to ground at alternate contact 23 of the supervisory relay SR. The relay CLR deenergizes but the relay SR is held energized over the circuit just traced independent of the now restored relay CLR. The closing of alternate contact 23 of the supervisory relay SR establishes an energizing circuit for the answering supervisory signal AS traced from battery through the signal AS, normal contact 25 of the relay SCR, conductor 126, normal contact 127 of the relay CLR, conductor 125 to ground at alternate contact 23 of the relay SR. Supervisory signal AS is lighted over this circuit and indicates to the operator that the calling subscriber at the magneto substation C' has replaced his receiver upon the switchhook and given the disconnect signal.

The called subscriber at magneto substation D after replacing his receiver upon the switchhook operates the hand generator thereat and the current from the hand generator operates the relay CLR'. The current from the hand generator extending therefrom through the tip contacts of the connected jack J^3 and plug CP, alternate contact 41 of the relay SUL, normal contact 68 of the relay RI, the winding "*c*" of the repeating coil RC, conductor 87, normal contact 88 of the relay SCR', conductor 128, normal contact 129 of the relay RCR, conductor 130, through the winding of the reley CLR', conductor 78, through the winding "*d*" of the repeating coil RC, the ring contacts of the connected plug CP and jack J^3 back to the generator of the substation D. The relay CLR' is energized by this flow of current while the hand generator is being operated and the closure of its alternate contact 131 establishes an energizing circuit for the supervisory relay SR' traced from battery through the lower winding of the relay SR', conductor 132, normal contact 85 of the relay SCR', conductor 133, normal contact 134 of the listening relay LS, conductor 135 to ground at alternate contact 131 of the relay CLR'. The relay SR' upon energization closes a locking circuit for itself traced from battery through the lower winding of the relay SR', conductor 132, normal contact 85 of the relay SCR', conductor 133, normal contact 134 of the listening relay LS, conductor 135, alternate contact 55 of the relay SR', conductor 56 to ground at normal contact 57 of the relay RT. The relay SR' remains energized over the circuit just traced independent of the relay CLR'. The closure of alternate contact 55 of the relay SR' closes a circuit for the supervisory signal SRL traced from battery through the lamp SRL, normal contact 53 of the ringing control relay RCR, conductor 54, normal contact 52 of the relay SCR', conductor 136, normal contact 137 of the ringing control relay RCR, conductor 138, normal contact 139 of the relay CLR', conductor 140, alternate contact 55 of the relay SR', and conductor 56 to ground at normal contact 57 of the relay RT. The lamp SRL is lighted over this circuit and gives the operator a disconnect signal which indicates to her that the called subscriber at substation D has replaced his receiver upon the switchhook. The operator noting the two lighted signals AS and SRL withdraws the plugs AP and CP from the respective jacks J^2 and J^3. The withdrawal of the plug CP from the jack J^3 brings about the deenergization of the relay SUL of the cord C and the cut off relay CO^3 of the line circuit L^3. The operator now actuates her listening key LK closing an energizing circuit for the listening relay LS traced from battery through the winding of the relay LS, conductor 32 to ground at alternate contact 31 of the listening key LK. The relay LS upon energization opens its normal contacts 123 and 134 and the opening of normal contact 123 opens the locking circuit for the supervisory relay SR and the supervisory relay SR upon deenergization opens the circuit for the supervisory lamp AS at alternate contact 23 and lamp AS is now effaced. The opening of normal contact 134 of the listening relay LS opens a locking circuit for the supervisory relay SR' and the supervisory relay SR' upon deenergization opens its alternate contact 55 to efface the supervisory signal SRL. The operator now restores her listening key LK and thereby opens the energizing circuit for the relay LS and the apparatus used in establishing the connection between the magneto substation C' and the magneto substation D is now at normal and available for establishing other connections.

Should a connection be established between a common battery substation A and a magneto substation D the operation of the circuit can be readily followed from

the previous description, and likewise the connection between substations C' and B is readily apparent from the foregoing description.

While I have described my invention in one specific form, I do not wish to be limited to the same, as changes and modifications will readily suggest themselves to those skilled in the art, and I, therefore, aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. In a telephone system of the character described including common battery and magneto telephone lines, universal link circuits for use in interconnecting said lines as calling and called lines, an operator's set, operator controlled means comprising a listening key, a listening relay operable upon the actuation of said operator controlled means for connecting said operator's set to a calling one of said common battery lines, and relay means in said link circuits including a clearing out relay adapted to be energized upon the connection of a second link circuit to a calling line, for preventing the connection of a second operator's set to said calling line subsequent to the connection of said first operator's set to said line.

2. A telephone system of the character described including common battery and magneto telephone lines, universal link circuits for use in interconnecting said lines as calling and called lines, an operator's set, a listening key and a listening relay, said relay operable upon the actuation of said listening key for connecting said operator's set to a calling one of said common battery lines, and relay means in said link circuits including an operator's relay, and a clearing out relay adapted to be energized upon the connection of a second link circuit to a calling line to cause said operator's relay to operate upon the actuation of said listening key to prevent the connection of a second operator's set to said calling line subsequent to the connection of said first operator's set to said line.

3. In a telephone system of the character described including common battery and magneto telephone lines, universal link circuits for use in interconnecting said lines as calling and called lines, an operator's set, a listening key and a listening relay, said relay operable upon the actuation of said listening key for connecting said operator's set to a calling one of said lines, and relay means in said link circuit including an operator's relay, and a clearing out relay adapted to be energized upon the connection of a second link circuit to a calling line to cause said operator's relay to operate upon the actuation of said listening key to prevent the connection of a second operator's set to said common battery calling line subsequent to the connection of said first operator's set to said line.

4. In a telephone system of the character described including a cord circuit adapted to connect subscribers' lines having either common battery or magneto substations in conversational circuit, an operator's set, a listening key and a listening relay, said relay operable upon the actuation of said listening key for connecting said operator's set to a calling one of said lines, an operator's cut out relay, and relay means in said cord circuits operating when a second cord is connected to said calling line subsequent to the connection of the first cord circuit to cause the said operator's cut out relay to operate when the listening key of said second cord is operated to prevent the operator's set of said second cord from being connected to said calling line.

5. In a telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal link circuit for use in connecting said lines, a repeating coil for said universal link circuit, a source of ringing current, a ringing control relay, a relay adapted to be operated intermittently over a circuit controlled by said ringing control relay to connect ringing current to a called subscriber's line, switching means controlled by said ringing control relay for short circuiting a winding of said repeating coil to prevent the discharge of the condensers of said called line from affecting said calling line.

6. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit including a repeating coil for use in connecting said lines, a source of ringing current, a relay adapted to be energized and deenergized to intermittently apply said ringing current to a called subscriber's line, a ringing control relay controlling the operation of said first relay, and switching means controlled by said ringing control relay for short circuiting a winding of said repeating coil to prevent the discharge of said called subscriber's line from affecting the calling line.

7. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit including a repeating coil for use in connecting said lines, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay to intermittently apply said ringing current to a called subscriber's line, a ringing control relay controlling the op-

eration of said ringing interrupter relay, switching means controlled by said ringing control relay, said switching means of said ringing control relay adapted upon the deenergization of the ringing interrupter relay to cause a shunt to be placed about a winding of said repeating coil to prevent the discharge of said called subscriber's line from affecting the calling line.

8. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit for interconnecting said lines, a repeating coil for said cord circuit, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay for intermittently applying ringing current to a called subscriber's telephone line, a ringing control relay controlling the operation of said ringing interrupter relay, a supervisory relay controlled over said called line, said supervisory relay controlling said ringing control relay, switching means controlled by said ringing control relay operative upon the deenergization of said ringing interrupter relay to prevent the premature deenergization of said ringing control relay.

9. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit for interconnecting said telephone lines, a repeating coil for said cord circuit, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay for intermittently applying ringing current to a called line, a ringing control relay controlling the operation of said ringing interrupter relay, a supervisory relay controlled over said called line for controlling said ringing control relay, switching means operative upon the deenergization of said ringing interrupter relay to cause a shunt to be placed about a winding of said repeating coil to prevent the discharge of said called subscriber's line from affecting the calling line, and other means operative upon the deenergization of said ringing interrupter relay adapted to prevent the premature deenergization of said ringing control relay.

10. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit for interconnecting said subscribers' telephone lines, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay for intermittently applying ringing current to a called subscriber's line, a ringing control relay controlling the operation of said ringing interrupter relay, an initial energizing circuit for said ringing control relay, a locking circuit for said ringing control relay, a supervisory relay controlled over said called line and adapted to energize to interrupt said locking circuit to cause the deenergization of said ringing control relay, and switching means operative upon the deenergization of said ringing interrupter relay adapted to prevent the premature deenergization of said ringing control relay.

11. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit for interconnecting said telephone lines, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay for intermittently applying ringing current to a called line, a ringing control relay controlling the operation of said ringing interrupter relay, an energizing circuit for said ringing control relay, and switching means operative upon the deenergization of the said ringing interrupter relay for connecting a source of battery current in parallel with said ringing control relay to render said ringing control relay sluggish to prevent the premature deenergization of said ringing control relay.

12. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's universal cord circuit for interconnecting said telephone lines, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay for intermittently applying ringing current to a called common battery telephone line, a ringing control relay for controlling the operation of said ringing interrupter relay, a supervisory relay controlled over said called line, a ringing trip relay controlled over said called line, a locking circuit for said ringing control relay, said supervisory relay adapted to operate to interrupt said locking circuit when said ringing interrupter relay is deenergized, said ringing trip relay adapted to operate to interrupt the said locking circuit when said ringing interrupter relay is energized and switching means operative upon the deenergization of said ringing interrupter relay to prevent the premature deenergization of said ringing control relay.

13. A telephone system of the character described including common battery and local battery subscribers' telephone lines, an operator's univesal cord circuit for interconnecting said telephone lines, a source of ringing current, a ringing interrupter relay, interrupter means for energizing and deenergizing said ringing interrupter relay

for intermittently applying ringing current to a called line, a ringing control relay for controlling said ringing interrupter relay, a repeating coil for said cord circuit, a supervisory relay controlled over said called line, a ringing trip relay controlled over said called line, a locking circuit for said ringing control relay, said supervisory relay adapted to operate only when said ringing interrupter relay is in a deenergized condition to interrupt the said locking circuit and cause said ringing control relay to deenergize, said ringing trip relay adapted to operate only when said ringing interrupter relay is in an energized condition to cause the deenegization of said ringing control relay, and switching means operative upon the deenergization of the said ringing interrrupter relay to cause a shunt to be placed about a winding of said repeating coil to prevent the discharge of said called line from affecting the calling line.

Signed by me at Chicago, county of Cook and State of Illinois, this 21st day of September, 1926.

MICHAEL B. STAZAK.