

March 25 , 1924.

C. SPARKS

1,487,761

TELEPHONE SYSTEM

Filed June 29, 1918

2 Sheets-Sheet 1

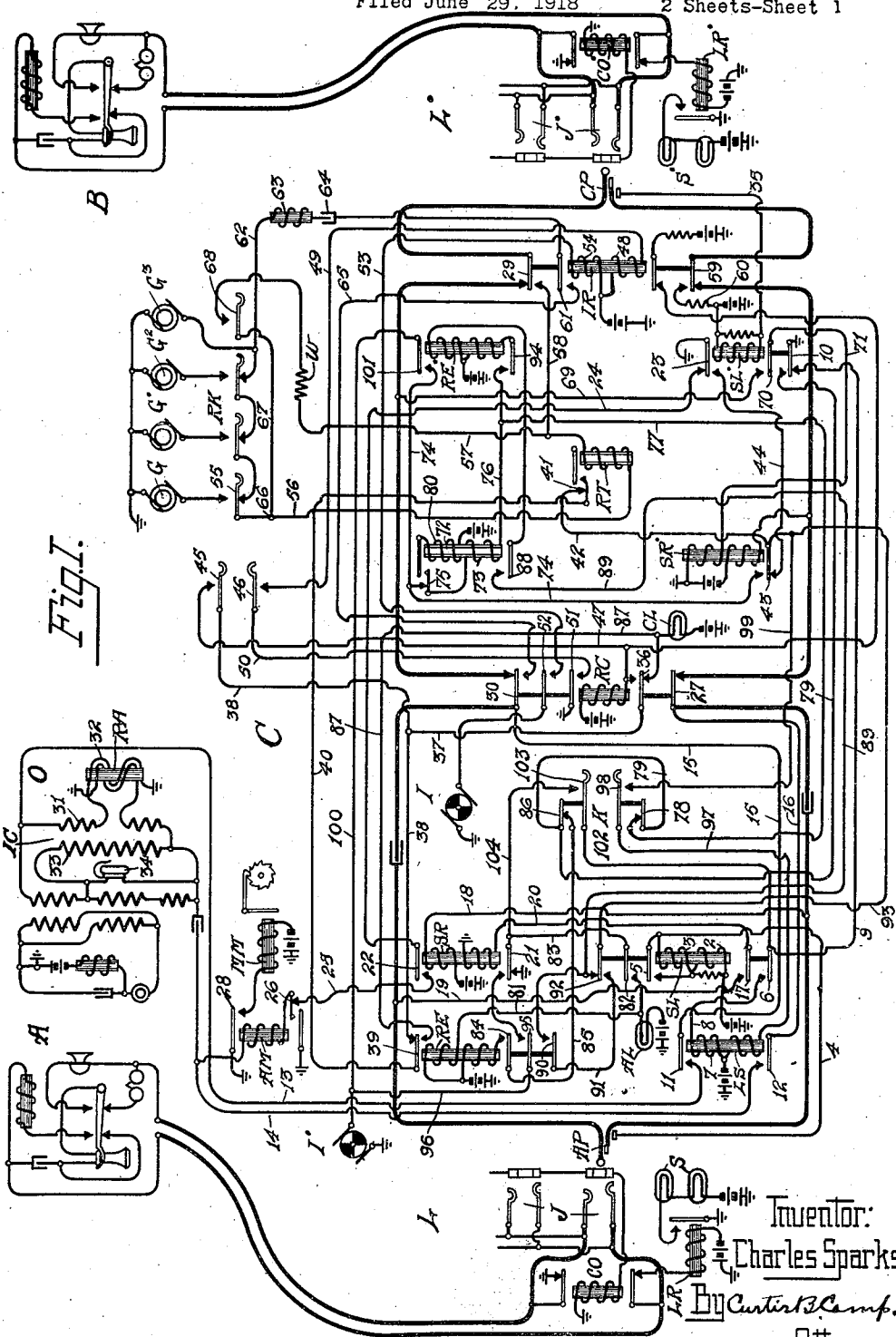


Fig. 1.

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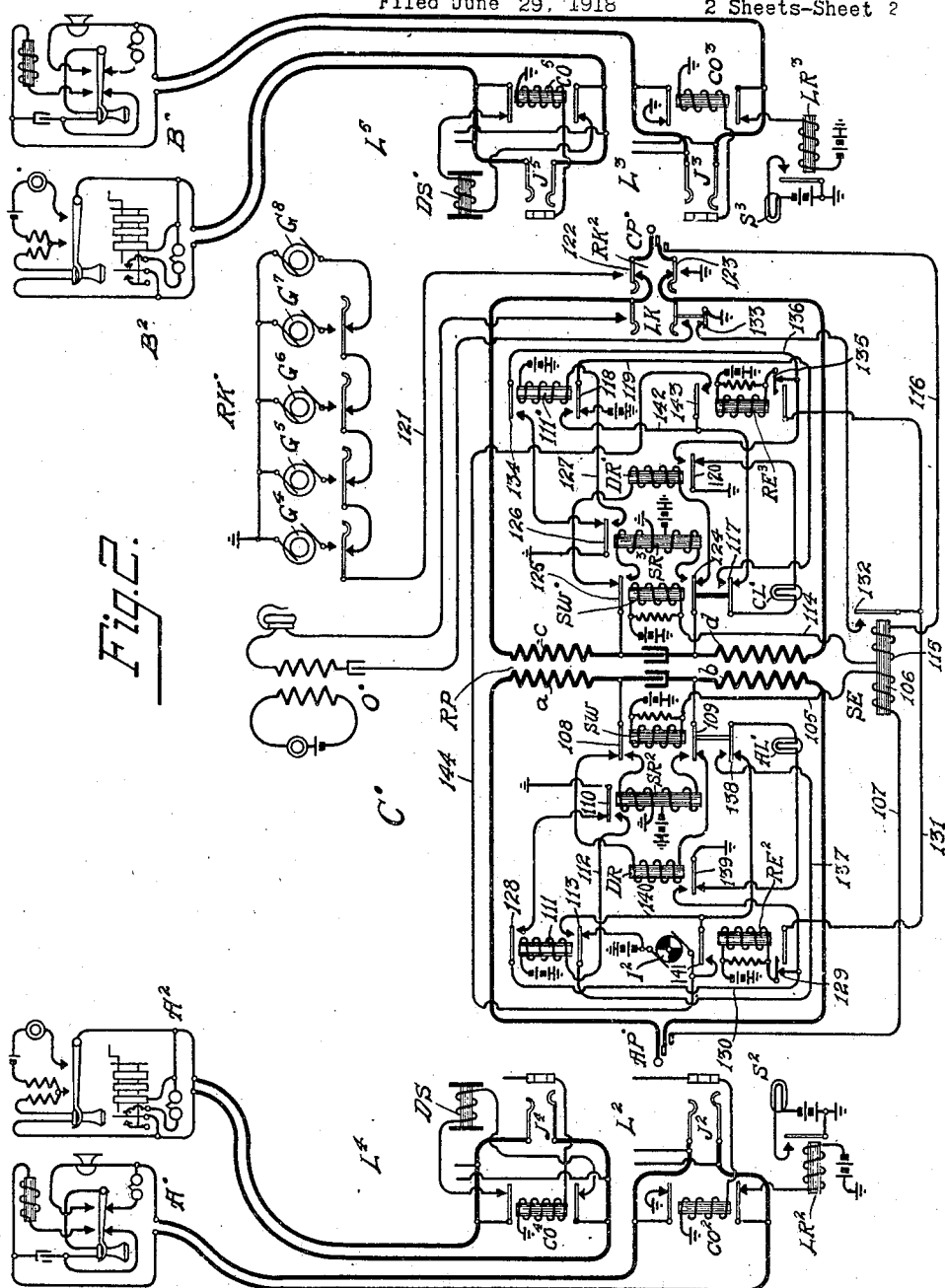
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TELEPHONE SYSTEM

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2 Sheets-Sheet 2



Inventor:
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Patented Mar. 25, 1924.

1,487,761

UNITED STATES PATENT OFFICE.

CHARLES SPARKS, OF OAK PARK, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed June 29, 1918. Serial No. 242,534.

To all whom it may concern:

Be it known that I, CHARLES SPARKS, a citizen of the United States of America, and resident of Oak Park, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with systems using link or cord circuits for use in completing connections between subscribers' telephone lines, and has for its object a novel and improved system of the above type.

One of the features of my invention is the provision of means whereby a calling subscriber may automatically flash his supervisory lamp when he wishes to recall, and a called subscriber may likewise flash his supervisory lamp when he wishes to recall.

Another feature of my invention is the provision of means whereby a called subscriber is prevented from automatically flashing his supervisory lamp for recall purposes until the calling subscriber has replaced his receiver upon its switch hook.

Another feature of my invention is the provision of automatic means for flashing the supervisory signals of a link circuit used for interconnecting telephone lines of different character, such as common battery and local battery telephone lines.

Another feature of my invention is the provision of novel means whereby the operator may answer recalls, under certain conditions, without removing the terminal plugs of the link circuit from the jacks of the connected lines.

These, as well as other features, will be more particularly pointed out in the ensuing specification and in the appended claims.

For a better understanding of my invention, reference may be had to the accompanying drawings which illustrate my invention operating in connection with telephone systems, in which

Figure 1 illustrates one form of my invention as applied to a common battery cord circuit; and

Figure 2 illustrates a modified form of my invention as applied to a universal cord circuit.

Referring now more particularly to Figure 1, I show a calling substation A and a

called substation B, the said substations terminating, respectively, at the exchange in line circuits L and L', respectively. The line circuits L and L' comprise the usual line relays LR and LR', cut-off relay CO and CO', multiple jacks J and J', and the line signals S and S'.

The cord circuit C for interconnecting the subscribers A and B as calling and called lines, respectively, is provided with an answering plug AP and a calling plug CP, said plugs AP and CP being connected by the heavily marked conductors. The answering end of the cord circuit is provided with a sleeve relay SL energized when the answering plug is inserted into the jack of a calling line. A supervisory relay SR is also provided, the energizing circuit of which is closed at the switch hook contacts of the calling substation. A listening relay LS is provided, energized upon the actuation of the sleeve relay SL to connect the operator's set O and cord conductors. A recall relay RE is also associated with the answering end of the cord circuit which is energized when the calling subscriber restores his receiver after termination of conversation to place the cord circuit in condition to allow the calling subscriber to recall, should he wish to do so. The relay RE is also energized, should the calling subscriber replace his receiver before the called subscriber answers, to prevent further application of ringing current to the called line. A recall key K is provided, which key when actuated allows the operator to seize the recall. An answering meter relay AM and a meter magnet MM are also associated with the answering end of the cord circuit C to register the calls answered by the operator. An answering supervisory lamp AL is also provided for the usual supervisory purposes.

Associated with the calling end of the cord circuit C is a sleeve relay SL' which is energized when the calling plug CP is inserted into the jack of the called line. The relay SL', upon energizing, opens the circuit of listening relay LS, which relay then restores, disconnecting the operator's set O from the cord conductors. A party line ringing key RK is also provided for connecting one of a plurality of ringing generators G, G', G² and G³ to signal the subscriber at the called-for substation. A ringing control relay RC is also provided, which relay is

energized upon the actuation of the ringing key RK to connect ringing current to the called line. An interrupter relay IR is also provided which is energized upon the actuation of the ringing key to connect ringing current to the called line to give an instantaneous first ring to the called-for subscriber. The relay RC also connects the interrupter I to the interrupter relay IR.

A ringing trip relay RT is provided which is actuated upon response of the called-for subscriber, should the called subscriber remove his receiver in response to the call signal during a ringing period. The relay RT, upon deenergizing, interrupts the circuit of the ringing control relay RC and the said relay RC in turn disconnects the interrupter I to allow the interrupter relay IR to remain at normal. A supervisory relay SR' is also provided which is actuated upon the response of the called subscriber to interrupt the circuit of the relay RC, should the called-for subscriber answer during a silent period. A calling supervisory lamp CL is provided, and is used for the usual supervisory purposes. A slow-acting relay 72 is provided which is energized upon the actuation of the supervisory relay SR', and a recall relay RE' is also provided, which relay energizes when the called subscriber replaces his receiver, after the termination of a conversation, to place the cord circuit in condition to allow the called subscriber to recall, should he desire to do so. The relay RE' duly operates after the calling subscriber has replaced his receiver, for purposes which will be more fully hereinafter described.

Referring now in general to Figure 2, I show a universal cord circuit C' adapted to interconnect telephone lines of different character; for example, to connect common battery and local battery telephone lines, common battery and common battery lines, or local battery and local battery lines. In Figure 2, I show a calling common battery substation A' and a calling local battery substation A², and to the right of the drawing, I show a called common battery substation B', and a called local battery substation B². The common battery substations A' and B' terminate at the exchange in line circuits L² and L³, which comprise the usual line relays LR² and LR³, cut-off relays CO² and CO³, line signals S² and S³, and multiple jacks J² and J³. The local battery substations A² and B² terminate at the exchange in the line circuits L⁴ and L⁵, respectively, the line circuits L⁴ and L⁵ comprising the high resistance wound cut-off relays CO⁴ and CO⁵, multiple jacks J⁴ and J⁵, and drop signals DS and DS'.

The universal cord circuit C' comprises an answering plug AP', and a calling plug CP', the two plugs being connected by

the heavily marked conductors and through the medium of a repeating coil RP, comprising the windings a, b, c and d. The answering end of the cord circuit C comprises a sleeve relay SE which is actuated when the plug AP' is inserted into either a jack of a common battery or a local battery line. A switching relay SW is provided, which relay energizes when the plug AP' is inserted into the jack of a common battery line, the said relay SW remaining at normal when the plug AP' is inserted into the jack of the local battery line due to the high resistance of the winding of the cut-off relay of the local battery line circuit. A supervisory relay SR² is provided which is actuated over the line when connection is made with the common battery line. A disconnect relay DR is also provided which is actuated when a local battery subscriber transmits a disconnect signal to the exchange by the operation of his hand generator. A recall relay RE² is also provided, which relay RE² connects interrupter I² to the answering supervisory lamp AL', should the calling common battery subscriber wish to recall. The said relay RE² also actuates when the local battery substation sends a disconnect signal which connects the interrupter I² with the lamp AL' to give the operator a flash disconnect signal. The relay SE is a double-wound relay, the left-hand winding being associated with the answering plug AP', and the right-hand winding being associated with the calling plug CP'. The calling end of the cord circuit C' contains similar apparatus to that described in connection with the answering end of the cord circuit C, namely, the switching relay SW', supervisory relay SR³, disconnect relay DR', and the recall relay RE³. A listening key LK is provided, which, when actuated, connects the operator's set O' to the cord conductors, and a ringing key RK² is also provided to connect ringing current to ring the local battery substation B² as a called line or to connect any one of the generators G⁴, G⁵, G⁶ or G⁷ to ring the desired common battery substation as a called line.

Having described in general the preferred arrangement of the circuits and apparatus employed in my invention, I will now describe it more in detail operating in connection with the exchange system illustrated.

Operation of cord circuit of Fig. 1.

Referring now more particularly to Fig. 1, and assuming that the subscriber at the calling substation A initiates a call, the removal of the receiver thereat brings about the energization of the line relay LR of the line circuit L, and the actuation of said relay LR brings about the lighting of the line

signal S. The operator associated with the cord circuit C, noting the lighted line signal S, inserts the answering plug AP of the cord circuit C into the answering jack J of the calling line. The act of inserting the plug AP into the jack J closes a series energizing circuit for the sleeve relay SL of the cord circuit C, and the cut-off relay CO of line circuit L, traced from battery through the windings 2 and 3 of the sleeve relay SL, conductor 4, sleeve contacts of the connected plug AP and jack J, and through the winding of the relay CO to ground. The alternate contact 5 of the relay LS having now closed, a different circuit is established for the sleeve relay SL, traced from battery, through the lower winding 2 of the relay SL, alternate contact 5 of the relay SL, conductor 4, sleeve contacts of the connected plug AP and jack J, and through the cut-off relay CO to ground. The shunting of the upper winding is to provide means for preventing a plurality of operators from connecting to a calling line.

The closing of alternate contact 6 of relay SL establishes an energizing circuit for the listening relay LS, traced from battery through the upper winding 7 of the relay LS, conductor 8, alternate contact 6 of relay SL, and conductor 9 to ground at normal contact 10 of the sleeve relay SL'. The closing of alternate contacts 11 and 12 of the listening relay LS connects the operator's set O to the cord conductors over conductors 13 and 14, through alternate contacts 11 and 12 of relay LS, and over conductors 15 and 16 to the tip and sleeve conductors of the cord circuit C. The closing of alternate contact 17 of relay SL closes a circuit of the supervisory relay SR, traced from battery, through the upper winding of the relay SR, conductor 18, ring contacts of the connected plug AP and jack J, through the substation, back over tip contacts of the connected jack J and plug AP, conductor 19, alternate contact 17 of relay SL, conductor 20, and through the lower winding of relay SR to ground. The opening of normal contact 21 of relay SR prevents the premature lighting of the answering supervisory lamp AL. The closing of alternate contact 22 of relay SR establishes an energizing circuit for the answering meter relay AM traced from ground at normal contact 23, of relay SL', over conductor 24, through alternate contact 22 of relay SR, conductor 25, normal contact 26 of relay AM, through the winding of said relay AM, conductor 14, alternate contact 12, conductor 16, normal contact 27 of ringing control relay RC, and through the lower winding of the relay SR' to battery and ground. The relay AM closes a locking circuit for itself, traced from ground at its alternate contact 26, through the winding of the said relay and over the

previously described path to battery and ground, through the lower winding of the supervisory relay SR'.

The closing of alternate contact 28 of relay AM closes an energizing circuit for the meter magnet MM traced from battery, through the winding of the magnet MM to ground at alternate contact 28 of relay AM. Magnet MM, upon energizing, steps the register one notch to register the connection answered by the operator associated with the cord circuit C.

The operator having been connected with the cord conductors inquires the wants of the calling subscriber at the substation A, and assuming it is the subscriber at the substation B that is wanted, the operator tests the multiple jack of the wanted line in the usual manner, by placing the tip of the calling plug CP to the sleeve of the multiple jack J' of the wanted line. If the wanted line is busy, the sleeve of the jack will be at a battery potential, causing a flow of battery through the tip of the plug CP, through the normal contacts 29 of relay IR, normal contact 30 of relay RC, conductor 15, alternate contact 11 of relay LS, conductor 13, through the winding 31 of the induction coil IC, and through the winding 32 of the retardation coil RA to ground. This induces an impulse of current into the winding 33 of the induction coil IC to produce a click in the operator's receiver 34, notifying the operator of the busy condition of the line.

Called line idle.

Assuming that the line is idle, the operator inserts the calling plug CP into the multiple jack J' of the called line, closing a series energizing circuit for the sleeve relay SL' and the cut-off relay CO' of the line circuit L', the circuit being traced from battery through the winding of the relay SL', conductor 35, sleeve contacts of the connected plug CP and jack J', and through the winding of the cut-off relay CO' to ground. The opening of the normal contact 10 of relay SL' opens the circuit of listening relay LS, said relay LS restoring opens its alternate contacts 11 and 12 to disconnect the operator's set O from the cord conductors. The opening of alternate contact 12 of relay LS opens the locking circuit of the answering meter relay AM, the said relay restoring to normal. The closing of alternate contact 23 of relay SL' establishes an energizing circuit for the calling supervisory lamp CL, traced from battery through the lamp CL, normal contact 36 of relay RC, conductor 37, conductor 38, normal contact 39 of relay RE, conductor 40, normal contact 41 of the ringing trip relay RT, conductor 42, normal contact 43 of relay SR', and conductor 44 to ground at alternate contact 23 of the relay SL'. The said

supervisory signal CL remains lighted until the called for subscriber is signaled by the operator. The operator now depresses the proper ringing key plunger of the ringing key RK to its fully depressed position, which moves the end spring contacts 45 and 46 of the ringing key RK to their alternate position and connects the proper ringing generator G, G', G² or G³ to signal the called for subscriber at substation B. The closing of alternate contact 45 of the end springs of the ringing key RK establishes an energizing circuit for the ringing control relay RC, traced from battery through the winding of the said relay RC, conductor 47, alternate contact 45, conductor 38, normal contact 39 of relay RE, conductor 40, normal contact 41 of relay RT, conductor 42, normal contact 43 of relay SR' and conductor 44 to ground at alternate contact 23 of relay SL'. The relay IR is also energized during the interval that the key is held down over a circuit traced from battery through the lower winding 48, conductor 49, alternate contact 46, and conductor 50 to ground at alternate contact 51 of the relay RC. The closing of alternate contact 29 of relay IR connects ringing current from the generator G, which we will assume is the selected ringing generator to the called line, giving an instantaneous first ring to the called subscriber's call bell at substation B. The closing of alternate contact 36 of relay RC establishes a locking circuit for the said relay RC, traced from battery through the winding of the relay RC, said alternate contact 36, conductor 37, conductor 38, normal contact 39 of relay RE, conductor 40, normal contact 41 of relay RT, conductor 42, normal contact 43 of relay SR' and conductor 44 to ground at alternate contact 23 of relay SL'.

The closing of alternate contact 52 of relay RC connects interrupter I to the interrupter relay IR, over a circuit traced from ground, through the constantly rotating interrupter I, through alternate contact 52 of relay RC, conductor 53, and through the upper winding 54 of relay IR to battery and ground. The relay IR is thus intermittently energized and de-energized to connect ringing current from the generator G over a circuit traced from the ungrounded pole of the generator G, through the alternate contact 55 of the ringing plunger contact, conductor 56, through the winding of the ringing trip relay RT, conductor 57, conductor 58, alternate contact 29 of the relay IR, tip contacts of the connected plug CP and jack J', through the condenser and call bell of the called substation B, through the ring contacts of the jack J' and plug CP, alternate contact 59, and through the resistance 60 to battery and ground.

The closing of alternate contact 61 of the

relay IR transmits a ringing tone to the calling subscriber at the substation A traced over a circuit extending from the generator G³, conductor 62, through resistance 63, condenser 64, alternate contact 61 of relay IR, conductor 65, alternate contact 30 of relay RC, tip contacts of the plug AP and jack J, through the substation receiver, back through the ring contacts of the jack J and plug AP, over conductor 18, and through the upper winding of the relay SR to battery, giving the calling subscriber at the substation A an audible signal, notifying him that the called subscriber is being signaled. The called subscriber at the substation B' is thus automatically signaled until the called subscriber at the substation B answers in response to his call signal, or until the calling subscriber replaces his receiver. The non-inductive winding W which is in multiple with the winding of the ringing trip relay RT is only connected to the low frequency of the ringing current, say the 16 cycle ringing current. Should the operator have depressed the ringing key plunger to connect the ringing generator G³, which we will say is the generator delivering 16 cycle ringing current, the said current will pass through the closed contacts of the ringing plungers from generator G³ to the point 66, the current then dividing, part passing over conductor 67, through alternate contact 68, through the resistance W, over conductors 57 and 58 and alternate contact 29 of relay IR to the call bell at the called substation, and back to battery and ground at alternate contact 59 of relay IR, while the other path which divides at point 66 passes over conductor 56, through the winding of relay RT, to battery and ground at alternate contact 59 of relay IR, as before described. Without this resistance W, should the low frequency current pass through the relay RT, the said relay might chatter, and open the locking circuit of the ringing control relay RC at contact 41, which would bring about the premature disconnection of the ringing current from the called line. The winding W in multiple with the winding of the relay RT prevents this chatter of the relay RT.

Should the subscriber at the called substation B answer during a silent period, that is, when the relay IR is in a de-energized condition, a circuit is closed through the supervisory relay SR', traced from battery through the lower winding of the said relay SR', normal contact 59 of relay IR, the ring contacts of the connected plug CP and jack J', through the now closed contacts of the substation switch hook, back through the tip contacts of the connected jack J' and plug CP, normal contact 29 of relay IR, conductor 69, alternate contact 70 of relay SL', conductor 71, and through the upper

winding of the relay SR' to ground. The opening of normal contact 43 of the relay SR' opens the locking circuit of the ringing control relay RC, which relay de-energizes to open its alternate contact 52, and the opening of said contact 52 disconnects the constantly rotating interrupter I from the upper winding 54 of the relay IR. The said relay RC now restores to normal, thus preventing the ringing current from being applied to the subscriber's line.

Should the called subscriber at substation B answer during a ringing interval, the ringing current is interrupted, due to the combined generator and battery flow through the ringing trip relay RT, which relay now operates over a circuit traced from the ungrounded pole of the generator G, alternate contact 55, conductor 56, through the winding of the said relay RT, conductors 57 and 58, alternate contact 29 of relay IR, the tip contact of the connected plug CP and jack J', through the now closed contacts of the substation switch hook back through the ring contacts of the connected jack J' and plug CP, through alternate contact 59 of relay IR, and through resistance 60 to battery and ground. The disconnection of the condenser at the substation permits the battery flow through the winding of relay RT to bring about the energization of the said relay RT. The relay RT energizing, opens its normally closed contact 41 to interrupt the locking circuit of the relay RC. The said relay RC restoring, opens its alternate contact 52 to disconnect the ringing interrupter I to prevent further application of ringing current to the called line.

The closure of normal contacts 29 and 59 of relay IR brings about the energization of the supervisory relay SR', as previously described. Upon the restoration of the relay RC and upon the energization of the supervisory relay SR', a portion of the battery flow through the calling supervisory lamp CL flows through the winding 73 of the relay 72 to bring about its energization, the circuit being traced from battery through the lamp CL, normal contact 36 of relay RC, conductors 37 and 38, normal contact 39 of relay RE, conductor 40, normal contact 41 of relay RT, conductor 42, the alternate contact 43 of relay SR', conductor 74, normal contact 75 of relay 72, the lower winding 73 of relay 72, conductor 76, conductor 77, normal contact 78 of the key K, and conductor 79 to ground at alternate contact 10 of the sleeve relay SL'. The battery flow through the lower winding of the relay 72 is sufficient to bring about the actuation of the said relay 72, which relay now closes a locking circuit for itself, traced from battery through the upper winding 80 of the said relay 72, its alternate contact 75, the lower winding 73, conductors 76 and 77,

normal contact 78 of key K, conductor 79 to ground at alternate contact 10 of relay SL', for purposes as will be more fully hereinafter described.

The calling and called subscribers A and B are now connected in conversational circuit, the talking circuit being traced over the heavily marked conductors. Should the calling subscriber at substation A restore his receiver before the called subscriber answers, the supervisory relay SR restores due to the opening of the switch hook contacts at the calling substation A. The closing of normal contact 21 of relay SR establishes an energizing circuit for the recall relay RE, traced from battery through the upper winding of the said relay RE, conductor 81, alternate contact 82 of relay SL, and conductor 83 to ground at normal contact 21 of relay SR. The closing of alternate contact 84 of relay RE establishes a locking circuit for itself, traced from battery through the lower winding of the said relay RE, alternate contact 84, conductor 85, normal contact 86 of key K, conductor 79, to ground at alternate contact 10 of relay SL'. The opening of normal contact 39 of the recall relay RE opens the locking circuit of the ringing control relay RC, which relay restores to open its alternate contact 52 to disconnect the ringing interrupter I, permitting the restoration of the interrupter relay IR. The said relay IR restoring prevents further application of ringing current to the called substation B.

The closing of normal contact 21 establishes an energizing circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, alternate contact 82 of relay SL, and conductor 83 to ground at normal contact 21. The closing of alternate contact 39 of relay RE establishes an energizing circuit for the supervisory lamp CL, traced from battery through the said lamp, conductor 87, alternate contact 39 of relay RE, conductor 40, normal contact 41 of relay RT, conductor 42, normal contact 43 of relay SR', and conductor 44 to ground at alternate contact 23 of relay SL'. The two supervisory lamps AL and CL being lighted, indicate to the operator that the calling subscriber has replaced his receiver and disconnection may take place.

Disconnection.

After the subscribers have finished conversation, they replace their receivers upon their respective switch hooks, causing the supervisory relays SR and SR' to restore. The restoration of the relay SR causes its normal contact 21 to establish an energizing circuit for the recall relay RE over a circuit as above described, and the restoration of the supervisory relay SR' closes an energizing circuit for the recall relay RE', over a circuit traced from battery through the

upper winding of the relay RE', alternate contact 88 of relay 72, conductor 89, the alternate contact 90 of relay RE, conductor 91, alternate contact 92 of relay SL, conductor 93, normal contact 43 of relay SR', and conductor 44 to ground at alternate contact 23 of relay SL'.

The relay RE', upon energizing, establishes a locking circuit for itself, traced from battery through the lower winding of the said relay RE', its alternate contact 94, conductors 76 and 77, normal contact 78 of key K, and conductor 79 to ground at alternate contact 10 of the sleeve relay SL'. The energizing circuits for the answering supervisory lamps AL and CL are also established as previously described, and the operator, noting the two lighted signals, removes the plugs AP and CP from their respective jacks J and J'. The removal of the plug AP from the jack J opens the series circuit of the cut-off relay CO and sleeve relay SL. The sleeve relay SL restoring, opens the locking circuit of the relay RE, and the removal of the plug CP from the jack J' opens the series circuit of the cut-off relay CO' and the sleeve relay SL'. The opening of the alternate contact 10 of relay SL' opens the energizing circuits of the relay 72 and the recall relay RE'. The cord circuit C is now at normal and is available for establishing other connections.

Recall by calling subscriber.

Assuming that the subscribers have finished conversation and before the plugs AP and CP have been withdrawn from the jacks, that the calling subscriber wishes to recall, the removal of the receiver at the substation A again closes an energizing circuit for the supervisory relay SR, through the closed contacts at the substation switch hook. The relay RE having been energized as before described, its alternate contact 95 is closed to connect the constantly rotating interrupter I' with the answering supervisory lamp AL, the circuit being traced from ground through the constantly rotating interrupter I', conductor 96, alternate contact 95 of relay RE, alternate contact 21 of the now energized relay SR, conductor 83, alternate contact 82 of relay SL, and through the answering supervisory lamp AL to battery. The answering supervisory lamp AL is caused to flash, due to the interrupter I', giving the operator at the cord circuit C a flashing recall signal, notifying her that the subscriber at the substation A wishes to recall. The operator noting the flashing signal actuates her recall key K to bring about the energization of the listening relay LS over a circuit traced from battery through the lower winding of the relay LS, conductor 97, the alternate contact 98 of the key K, conductor 99, normal contact

43 of the relay SR', and conductor 44 to ground at alternate contact 23 of relay SL'. The relay LS again energizes to close its alternate contacts 11 and 12 to connect the operator's set O to the cord conductors, and the operator now inquires the wants of the recalling subscriber at substation A. The opening of the normal contact 86 of the key K opens the locking circuit of the recall relay RE, the said relay RE restoring to normal opens its alternate contact 95 to disconnect the interrupter I' from the answering supervisory lamp AL to prevent further flashing of the said supervisory lamp AL. The opening of normal contact 78 of the key K brings about the de-energization of the relay 72 and recall relay RE'.

If another subscriber other than B is wanted by the recalling subscriber at substation A, the operator removes the calling plug CP from the connected jack J' and inserts it into another jack of the wanted line. The calling plug CP having been removed, the relay SL' restores to normal, opening its alternate contact 23, which brings about the de-energization of the listening relay LS which disconnects the operator's set O, and another insertion of the plug CP into another jack allows the circuit to be operated as previously described.

Recall by called subscriber.

Assuming that the called subscriber at the substation B wishes to recall after the subscribers have replaced their receivers upon their respective switch hooks, the removal of the receiver by the subscriber at the substation B brings about the energization of the supervisory relay SR' through the now closed switch hook contacts of the recalling substation B. The relays 72 and RE' having been energized as previously described, the interrupter I' is connected through to the calling supervisory signal CL, the circuit being traced from ground through the constantly rotating interrupter I', conductor 100, alternate contact 101 of the relay RE', conductor 74, alternate contact 43 of relay SR', conductor 42, normal contact 41 of relay RT, conductor 40, alternate contact 39 of relay RE, (the relay RE having been energized upon the restoration of the receiver at the calling substation A,) conductor 87, and through the lamp CL to battery. The lamp CL is flashed by the interrupter I', and the operator noting the flashing signal CL knows that the called subscriber at the substation B is recalling. The operator now actuates her key K to bring about the energization of the listening relay LS, the circuit being traced from battery through the upper winding of the relay LS, over conductor 8, alternate contact 6 of relay SL, conductor 102, alternate contact 103 of the key K, and conductor 104

to ground at normal contact 21 of the relay SR, the said relay SR having restored when the calling subscriber at substation A replaced his receiver.

5 The closing of alternate contacts 10 and 11 of the relay LS again connects the operator's set O to the cord conductors to inquire the wants of the recalling subscriber at the substation B.

10 The opening of normal contact 78 of the key K brings about the de-energization of relay 72 and recall relay RE', and the opening of alternate contact 101 of relay RE' opens the circuit of the supervisory lamp CL to prevent further flashing of said lamp, and the operation of the apparatus in re-establishing a connection for the subscriber at the substation B is readily apparent without further description.

20 From the above description, it may be noted that the called subscriber at substation B may only recall after the calling subscriber at substation A has replaced his receiver upon the switch hook, so that should the called subscriber at substation B in answering a call fumble his receiver in removing it from the switch hook, thereby accidentally closing the switch hook contacts and then again opening them, and finally closing them in answering a call, the flashing of the calling supervisory lamp CL will not be established, due to the fact that the recall relay RE associated with the answering end of the cord circuit C has not been actuated, and as alternate contact 39 is not closed the calling supervisory lamp is not affected so that a false recall signal will not be sent.

Operation of Figure 2.

40 In Figure 2, I show a modified form of my invention in the form of a universal cord circuit in which either the calling or called local battery subscribers may initiate a flash disconnect signal upon the termination of conversation and in which a calling or a called common battery subscriber may initiate a flash recall after termination of conversation. The cord circuit is also arranged so that an operator can distinguish between a disconnect and a recall signal.

Assuming now that the common battery subscriber at the substation A' initiates a call, the removal of the receiver thereat establishes an energizing circuit for the line relay LR², which relay, upon energization, brings about the lighting of the line signal S². The operator noting the lighted signal S² throws her listening key LK to connect her operator's set O' to the cord conductors of the cord circuit C, and inserts the answering plug AP' into the jack J² of the calling line. A series energizing circuit is established for the cut-off relay CO², the sleeve relay SE and the switching relay SW,

this circuit being traced from battery through the winding of the switching relay SW, conductor 105, winding 106 of the relay SE, conductor 107, sleeve contacts of the connected plug AP' and jack J², and through the winding of the cut-off relay CO² to ground. The closing of alternate contacts 108 and 109 of the switching relay SW connects the supervisory relay SR² to the cord conductors, which relay SR² now operates over the line through the closed contacts of the substation switch hook. The closing of alternate contact 110 of the relay SR² establishes an energizing circuit for the relay 111, traced from battery through the winding of the said relay 111, and conductor 112, to ground at alternate contact 110 of relay SR². The opening of normal contact 113 of relay 111 prevents the premature lighting of the answering supervisory lamp AL'. 70 75 80 85

Common battery to common battery.

The operator now inquires the wants of the calling subscriber, and assuming that it is the subscriber at the common battery substation B' that is wanted, the operator tests the multiple jack J³ of the called line in the usual manner, and assuming that the line is idle, she inserts the calling plug CP' into the jack J³ of the called line to close a series energizing circuit for the cut-off relay CO³ and switching relay SW', the circuit being traced from battery through the winding of the switching relay SW', conductor 114, winding 115 of relay SE, conductor 116, sleeve contacts of the connected plug CP' and jack J³, and through the winding of cut-off relay CO³ to ground. The switching relay SW' and the cut-off relay CO³ are thus energized in series. The relay SE is held energized, it having been energized upon the insertion of the answering plug AP' into the jack J² of the calling line. The closing of alternate contact 117 of switching relay SW' establishes an energizing circuit for the calling supervisory lamp CL', traced from battery through normal contact 118 of relay 111', conductor 119, alternate contact 117 of relay SW', and through the lamp CL' to ground at normal contact 120 of the disconnect relay DR', said lamp CL' remaining lighted until the called subscriber at substation B' answers. The operator now depresses the proper ringing plunger of the ringing key RK' to connect one of the generators G⁴, G⁵, G⁶ or G⁷ of the proper frequency to ring the call bell of the called subscriber at the common battery substation B', the path of the ringing current being traced from the ungrounded pole of the generator G⁴, which we will assume is the generator connected, through the closed contact of the ringing key plunger, conductor 121, alternate contact 122 of the ringing key RK², which is also actuated to connect 90 95 100 105 110 115 120 125 130

ringing current to the called line, the tip contacts of the connected plug CP' and jack J³, through the condenser and call bell at the substation B¹, back through the ring contacts of the connected jack J³ and plug CP', and through alternate contact 123 of the ringing key RK² to ground. The call bell of the called substation B¹ is thus actuated each time the key RK² is actuated, and upon the response of the called subscriber at substation B¹ a circuit is established for the supervisory relay SR³ traced from battery through the lower winding of the said relay, alternate contact 124 of relay SW', normal contact 123 of the ringing key RK², ring contacts of the connected plug CP' and jack J³, through the now closed contacts of the substation switch hook, back through the tip contacts of the connected plug CP' and jack J³, normal contact 122 of ringing key RK², through alternate contact 125 of relay SW', and through the upper winding of relay SR³ to ground. The closing of alternate contact 126 of relay SR³ establishes an energizing circuit for the relay 111' traced from battery through the winding of the said relay 111' and conductor 127 to ground at alternate contact 126 of relay SR³. The opening of normal contact 118 of relay 111' effaces the supervisory signal CL' notifying the operator that the called subscriber at the substation B has answered. The subscribers are now in conversational circuit, the said talking circuit being traced over the heavily marked conductors.

Assuming that the subscribers have finished conversation, they replace their receivers upon their respective switch hooks at the substations A' and B'. The replacing of the receiver at the substation A' brings about the de-energization of the supervisory relay SR². The opening of alternate contact 110 of relay SR² opens the energizing circuit for the relay 111. but the relay 111 being slow to release, holds its alternate contact 128 closed momentarily, bringing about the energization of the recall relay RE², traced from battery through the winding of the said relay RE², normal contact 129 of relay RE², conductor 130, and alternate contact 128 to ground at normal contact 110 of relay SR². The relay RE², upon energizing, establishes a locking circuit for itself traced from battery through the winding of the said relay, its alternate contact 129, conductor 131 and through alternate contact 132 of relay SE to ground at normal contact 133 of listening key LK. The replacing of the receiver at the called substation B' brings about the de-energization of the supervisory relay SR³, and the opening of alternate contact 126 of the relay SR³ opens the energizing circuit of the relay 111', but the relay 111' being slow to release, its

alternate contact 134 is momentarily held closed to establish an energizing circuit for the recall relay RE³ over a circuit traced from battery through the winding of the recall relay RE³, normal contact 135 of relay RE³, conductor 136 and alternate contact 134 of relay 111' to ground at normal contact 126 of relay SR³. The relay RE³ now closes a locking circuit for itself traced from battery through the winding of the said relay, its alternate contact 136, and through alternate contact 132 of relay SE to ground at normal contact 133 of listening key LK. The closing of normal contact 113 of relay 111 brings about the lighting of the answering supervisory lamp AL' over a circuit traced from battery through said normal contact 113, conductor 137, alternate contact 138 of relay SW and through the lamp AL' to ground at normal contact 139 of the relay DR.

The closing of normal contact 118 of relay 111' closes a circuit for the calling supervisory lamp CL', traced from battery at said normal contact 118, over conductor 119, through alternate contact 117, through calling supervisory lamp CL', to ground at normal contact 120 of relay DR'. The operator noting the two lighted supervisory signals AL' and CL', knows that conversation has been terminated, and withdraws the plugs AP' and CP' from their respective jacks J² and J³. The withdrawal of the plug AP' from the jack J² allows the relay SW of the cord circuit C' and the cut-off relay CO² of the line circuit L² to restore. The removal of the plugs P' from the jack J³ allows the switching relay SW' the relay, SE, and the cut-off relay CO³ to restore, and the opening of alternate contact 132 of relay SE opens the locking circuits of the recall relays RE² and RE³. The apparatus of cord circuit C' is now at normal and available for establishing other connections.

Assuming that conversation has terminated, and, before the plugs AP' and CP' have been withdrawn from their respective jacks, the subscriber at the substation A' wishes to recall, the removal of the receiver at the substation A' again energizes the supervisory relay SR² over the line, and the closing of its alternate contact 110 establishes an energizing circuit for the relay 111. As the relay RE² is energized upon the subscriber at substation A' replacing his receiver, the constantly rotating interrupter I² is now connected to the answering supervisory lamp AL' over a circuit traced from ground through normal contact 139 of relay DR, through the lamp AL', alternate contact 138 of relay SW, conductor 137, alternate contact 113 of relay 111, conductor 140, through alternate contact 141 of relay RE² and through the interrupter I² to battery and ground. The lamp AL' is

thus flashed, due to the constantly rotating interrupter I^2 and the flashing signal notifies the operator that the calling subscriber A' wishes to recall. The operator now actuates her listening key LK to connect her operator's set O' to the cord conductors to inquire the wants of the recalling subscriber at sub-station A' , and upon the actuation of the key LK , normal contact 133 is interrupted to open the locking circuit of the recall relay RE^2 , which relay restores to open its alternate contact 141 to disconnect the interrupter I^2 to prevent further flashing of the answering supervisory lamp AL' . If a subscriber other than the subscriber B' is wanted by the recalling subscriber at sub-station A' , the operator withdraws the plug CP' from its connected jack and inserts it into the jack of the now wanted subscriber. The removal of the plug CP' from the jack J^3 allows relays SW' , SE and CO^3 to restore, and the operation of the apparatus in establishing another connection is readily apparent.

Assuming that the called subscriber at substation B recalls, the removal of the receiver at the substation B' again brings about the energization of the supervisory relay SR^3 over the line, and the closing of alternate contact 126 of relay SR^3 brings about the energization of the relay 111', and the closing of its alternate contact 118 now connects the constantly rotating interrupter I^2 in circuit with the calling supervisory lamp CL' , said circuit being traced from ground at normal contact 120 of relay DR' through the lamp CL' , alternate contact 117' of relay SW' , conductor 119, alternate contact 118 of relay 111', conductor 142, through alternate contact 143 of the recall relay RE^3 , conductor 144, and through the rotating interrupter I^2 to battery and ground. The calling supervisory lamp CL' is thus flashed, and the flashing signal CL' notifies the operator that the subscriber at the substation B' is recalling. The operator now actuates her listening key LK to connect her operator's set O' to the cord conductors and inquires the wants of the recalling subscriber at the substation B' . The opening of the normal contact 133 of the listening key LK opens the locking circuit for the recall relay RE^3 . The said relay RE^3 restores and opens its alternate contact 143 to disconnect the interrupter I^2 , thereby preventing further flashing of the calling supervisory lamp CL' . The method of establishing another connection for the recalling subscriber at substation B' is readily apparent and further description is not necessary.

Local battery to local battery.

Assuming now that the local battery substation A^2 initiates a call, the actuation of

the hand generator at the substation A^2 brings about the operation of the drop signal DS , and the operator noting the actuation of signal DS inserts the answering plug AP' into the jack J^4 of the calling line. This establishes a series energizing circuit for the cut-off relay CO^4 and the sleeve relay SE of the cord circuit C' , said circuit being traced from battery through the winding of the switching relay SW , over conductor 105, winding 106 of relay SE , conductor 107, sleeve contacts of the connected plug AP' and jack J^4 , and through the winding of the cut-off relay CO^4 to ground. The cut-off relay CO^4 and sleeve relay SE are actuated, but due to the high resistance of the cut-off relay CO^4 of the local battery line circuit L^4 , the switching relay SW fails to operate and remains at normal. The operator now actuates her listening key LK to connect her operator's set O' with the cord conductors and inquires the wants of the calling subscriber, and assuming that it is the local battery subscriber at substation B^2 that is wanted, the operator tests the line in the usual manner. Assuming that line B^2 is idle, the operator inserts the answering plug CP' into the jack J^5 of the wanted line. A circuit for the cut-off relay CO^5 of line circuit L^5 may be traced from battery through the winding of the switching relay SW' , conductor 114, winding 115 of relay SE , conductor 116, sleeve contacts of the connected plug CP' and jack J^5 , and through the winding of the cut-off relay CO^5 to ground. The switching relay SW' does not operate due to the high resistance of the cut-off relay CO^5 and remains at normal, the sleeve relay SE having been already energized when the plug AP' was inserted into the jack J^4 of the calling line. The operator now actuates the ringing key RK^2 to connect the ringing generator G^8 to ring the call bell of the called-for subscriber at substation B^2 , the path for the ringing current being traced from the ungrounded pole of the generator G^8 , through the normal series contact of the ringing key RK' to alternate contact 122 of the ringing key RK^2 , tip contact of the connected plug CP' and jack J^5 , through the call bell of the substation B^2 , back to the ring contacts of the connected jack J^5 and plug CP' to ground at alternate contact 123. The operator thus rings the call bell at the substation B^2 until the called subscriber thereat answers. Assuming that the subscriber has answered, the conversational circuit may be traced over the heavily marked conductors.

Assuming that the subscribers have finished conversation, the subscribers at the substations A^2 and B^2 restore their receivers upon their respective switch hooks and actuate their hand generators to give the disconnect signal to the operator of the cord circuit C' . The subscriber at substation A^2

having actuated his hand generator, current will pass through the disconnect relay DR of the cord circuit C', the circuit being traced from the hand generator at substation A², over the tip contacts of the jack J⁴ and plug AP', normal contact 108 of relay SW, through the winding of relay DR, normal contact 109 of relay SW, ring contacts of the connected plug AP' and jack J⁴, back to the generator of the substation A². When current passes through the disconnect relay DR, it closes its alternate contact 139, bringing about the energization of the recall relay RE², traced from battery through the winding of relay RE² and normal contact 139 of relay RE² to ground at alternate contact 139 of relay DR.

The closing of alternate contact 129 of relay RE² establishes a locking circuit for said relay RE², as previously described, and when the subscriber at substation A² has ceased actuating his hand generator, relay DR restores to normal. The closing of alternate contact 141 of relay RE² connects the interrupter I² to the lamp AL', the circuit being traced from battery through the interrupter I², through alternate contact 141, conductor 140, normal contact 138 of relay SW, and through the lamp AL' to ground at normal contact 139 of relay DR. The lamp AL' is flashed due to the interrupter I², giving the operator of the cord circuit C', a flashing disconnect signal, or if code signals have been arranged, the subscriber at the substation A² may actuate his generator according to a certain code and notify the operator at the cord circuit C' whether the flashing signal is either a disconnect signal or a recall signal.

The operator noting the flashing signal actuates her listening key LK to interrupt the normal contact 133, should the flashing signal be a recall, and the opening of its contact 133 interrupts the circuit of relay RE² to open its alternate contact 141 to prevent further flashing of the signal AL'.

Assuming that the subscriber at the local battery substation B² actuates his hand generator after finishing conversation, the current from the hand generator actuates the disconnect relay DR', as is apparent from the previous description in connection with relay DR.

The closing of alternate contact 120 of relay DR' establishes a circuit for the recall relay RE³, traced from battery through the winding of said relay, normal contact 135 of relay RE³, and through alternate contact 120 of relay DR' to ground, and the closing of alternate contact 125 of relay RE³ establishes a locking circuit for the said relay RE³ to ground at normal contact 133.

When the subscriber at the substation B² has finished sending a disconnect signal, the

relay DR' restores to normal, closing the circuit for the calling supervisory lamp CL', traced from ground at normal contact 120 of relay DR' through the lamp CL', normal contact 117 of SW', alternate contact 143, conductor 144, and through the interrupter I² to battery and ground. The calling supervisory lamp CL' is caused to flash, due to the constantly rotating interrupter I², to give the operator a flashing disconnect signal, or in case of a code signal to signal the operator for a recall. In answering a recall, the operator actuates the listening key LK to connect her operator's set O' to the cord conductors. The opening of normal contact 133 of the key LK opens the locking circuit of the relay RE³, and the opening of the alternate contact 143 of relay RE³ disconnects the interrupter I² and the calling supervisory lamp CL' to prevent further flashing of the said lamp.

Common battery to local battery.

Should a calling common battery subscriber at the substation A' wish to converse with the local battery subscriber at substation B², the insertion of the plug AP' into the jack J² brings about the energization of the relays CO², SE, and switching relay SW, as previously described, and the closing of alternating contacts 108 and 109 of relay SW brings about the actuation of the supervisory relay SR² over the line. The operator in inserting the calling plug CP' into the jack J⁵ of the local battery line B² brings about the energization of the cut-off relay CO³ traced from battery through the switching relay SW' to ground. This circuit also passes through the winding 115 of the relay SE. The switching relay SW' does not operate when connected to the local battery line for reasons as previously described. The calling subscriber at the substation A' may recall after replacing his receiver upon his switch hook in the manner as previously described, and the local battery subscriber at the substation B² may transmit a flashing disconnect signal to the operator of the cord circuit C, as is readily apparent from the previous description.

The subscriber at local battery substation A² when calling actuates his drop signal DS, and the operator in response thereto inserts the answering plug AP' into the jack J⁴ of the calling line. In this instance, the cut-off relay CO⁴ and the sleeve relay SE are actuated through the switching relay SW to battery. The switching relay SW does not operate due to the high resistance of the cut-off relay CO⁴. Should the common battery substation B' be wanted, the operator inserts the plug CP' into the jack J³ of the called line, and this act brings about a series energizing circuit for the cut-off relay CO³ and the switching relay

SW', the relay SE having been energized when the answering plug AP' was inserted into the jack J⁴ of the calling local battery line. The disconnect signal from the local
 5 battery calling substation A² is the same as previously described, and the disconnect signal from the called common battery substation B' is the usual lighted supervisory signal CL', and should the called subscriber
 10 B' initiate a recall the operation of the apparatus used in establishing this recall is the same as previously described.

While I have illustrated several forms of my invention, I do not wish to be limited to
 15 the same as various other arrangements may readily suggest themselves to those skilled in the art, and I, therefore, wish to cover all such changes and modifications as come within the spirit and scope of the appended
 20 claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including a calling and a called subscriber's telephone line, a
 25 link circuit provided with an answering and a calling terminal for connecting said lines, an operator's telephone for said link circuit but normally disconnecting therefrom, automatic means for connecting and disconnecting
 30 said operator's telephone and said link circuit, said means also serving to prevent more than one operator from answering the same call at the same time, a supervisory signal associated with said calling terminal,
 35 subscriber-controlled means for causing a continuous operation of said signals, automatic means including a relay for flashing said answering signal, automatic means including a second relay for flashing said calling
 40 supervisory signal, a third relay, and circuits for said first and second relays controllable by said third relay.

2. A telephone system including a pair of subscribers' telephone lines, a link circuit
 45 provided with answering and calling terminals for connecting said lines, an answering and a calling supervisory signal for said link circuit, subscriber-controlled means for causing a continuous operation of said answering
 50 supervisory signal, a recall relay for connecting a circuit interrupter to said answering signal, a second relay for connecting said circuit interrupter to said calling signal, a third relay having a circuit including
 55 a contact of one of said terminals, and contacts controllable by said third relay controlling circuits for said first and second relays.

3. A telephone system including a pair of
 60 subscribers' telephone lines, a link circuit provided with an answering terminal and a calling terminal for connecting said lines, an operator's telephone for said link circuit but normally disconnecting therefrom, automatic
 65 means for connecting and disconnect-

ing said operator's telephone and said link circuit, said means also serving to prevent more than one operator from answering the same call at the same time, an answering
 70 supervisory signal and a calling supervisory signal for said link circuit, subscriber-controlled means for causing a continuous operation of said calling supervisory signal, a source of interrupter current, a relay for
 75 connecting said source to said first signal, a relay for connecting said source of current to said second signal, and circuits for said relays controllable by a third relay.

4. A telephone system including a pair of subscribers' telephone lines, a link circuit
 80 provided with an answering terminal and a calling terminal for connecting said lines, an operator's telephone for said link circuit but normally disconnecting therefrom, automatic means for connecting and disconnecting
 85 said operator's telephone and said link circuit, said means also serving to prevent more than one operator from answering the same call at the same time, an answering supervisory signal and a calling supervisory
 90 signal for said link circuit, a source of current, means for connecting said source of current in circuit with said signals to cause a continuous operation thereof, a source of interrupter current, a relay for connecting
 95 said source to said first signal, a relay for connecting said source of current to said second signal, circuits for said relays controllable by a third relay, and a circuit for said third relay including a contact of one
 100 of said terminals.

5. A telephone system including a calling subscriber's telephone line, a called subscriber's telephone line, a link circuit for connecting
 105 said lines, an operator's telephone, automatic means for connecting and disconnecting said operator's telephone and said link circuit, an answering supervisory signal and a calling supervisory signal for said link circuit, a source of current, subscriber-controlled
 110 means for connecting said source of current in circuit with said supervisory signals to cause a continuous operation thereof, a source of interrupter current, automatic means for connecting said source of current
 115 to said answering signal, and automatic means for connecting said source of current to said calling signal, said last means being operable only when the calling subscriber has first replaced his receiver, said first automatic
 120 means also serving to prevent more than one operator from answering the same call at the same time, and also to close contacts in the circuit of the automatic means connecting said source of interrupter current
 125 to said answering signal.

6. A telephone system including a pair of telephone lines, a link circuit for connecting
 130 said lines in conversational circuit, an operator's telephone, automatic means

for connecting and disconnecting said operator's telephone and said link circuit, automatic ringing means for signaling the called one of said subscribers' lines, operator-controlled means for initiating the operation of said automatic ringing, an answering signal and a calling signal for said link circuit, a source of interrupter current, automatic means for connecting said source of current to said answering signal, and automatic means for connecting said source of current to said calling signal, said last means being controlled by both said calling and said called subscribers, said first automatic means also serving to prevent more than one operator from answering the same call and also to close contacts in the circuit of the automatic means connecting said source of current to said answering signal.

7. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines in conversational circuit, automatic intermittent ringing means, operator controlled means for initiating the operation of said ringing means and for insuring that ringing current is applied to the called line at the moment the operator controlled means is actuated, means controlled by the calling subscriber for automatically disconnecting said ringing means and said link circuit, a calling supervisory signal for said link circuit, a source of interrupter current, and automatic means for connecting said source of current in circuit through a contact controlled by said ringing disconnect means with said calling supervisory signal, said last means being dependent upon the disconnection of said ringing means and said link circuit and also upon the calling subscriber having signaled for disconnection or recall and the called subscriber having signaled for a call.

8. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting said operator's telephone to said link circuit when the link circuit is connected to the calling subscriber's line, automatic means for disconnecting the operator's telephone from the link circuit when the link circuit is connected to the called line, a supervisory signal for said link circuit; automatic means for flashing said supervisory signal, said automatic means being operative only after said calling subscriber has signaled for disconnection or recall and said called subscriber has signaled for a connection, said last automatic means controlled over circuits controlled by the automatic means for connecting and disconnecting said operator's telephone and said link circuit.

9. A telephone system including a call-

ing subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, automatic ringing means for said link circuit, a signal for said link circuit, a circuit for said signal adapted to be closed when a link circuit is connected to the called line, means for opening said circuit when the automatic ringing means is associated with the called line, a supervisory relay for said link circuit controlled by said calling subscriber, a supervisory relay for said link circuit controllable by said called subscriber, and means for automatically flashing said signal, said means being controllable by both of said supervisory relays.

10. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, automatic ringing means for said link circuit, a signal for said link circuit, said signal adapted to glow when the link circuit is connected to the called line and adapted to be extinguished when said automatic ringing means is operated, a supervisory relay for said link circuit controlled by said calling subscriber, a supervisory relay for said link circuit controllable by said called subscriber, means for automatically flashing said signal, said last means being operable only when said answering supervisory relay is operated to signal for disconnection or recall and said calling supervisory relay is energized.

11. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, an operator's telephone, electromagnetic means for connecting and disconnecting said operator's telephone and said link circuit, a supervisory signal for said link circuit, means for automatically flashing said supervisory signal controllable by one of said subscribers, said means being inoperative to flash said supervisory signal unless the other of said subscribers has replaced his receiver, said electromagnetic means controlling contacts in the circuit of said supervisory signal and said last means, and operator controlled means for actuating said electromagnetic means when answering a recall.

12. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, automatic ringing means for signaling one of said subscriber's lines, a supervisory signal for said link circuit, means for automatically flashing said supervisory signal controllable by one of said subscribers, means controllable by the other of said subscribers for preventing said first subscriber from causing said supervisory signal to be flashed, an operator's telephone, electromagnetic means for connecting said operator's telephone to said link circuit when the operator answers

a recall, and automatic means controlled by the calling subscriber to disconnect ringing current from the called line, and to operate means to signal for a disconnection prior to the response of said called subscriber.

13. A telephone system including a pair of subscribers' lines, a link circuit connecting said lines, automatic means for said link circuit for preventing more than one link circuit from connecting to a subscriber's line, a signal for said circuit, means for automatically and intermittently operating said signal controlled over one of said telephone lines, the operation of said means controlled by the operation of said automatic means, and means controlled over the other of said telephone lines for controlling said first means.

14. A telephone system including a calling and a called subscriber's telephone line, a link circuit for connecting said lines, other link circuits, automatic means for preventing more than one of said link circuits from connecting to said calling subscriber's telephone line when attempting to answer a call, an answering and a calling supervisory signal for said link circuit, automatic means including a double-wound relay for flashing said answering signal, the initial operation of said automatic means for flashing said answering signal controlled by said first automatic means, and automatic means including a second double-wound relay for flashing said calling signal.

15. A telephone system including a calling and a called subscriber's telephone line, a link circuit for connecting said lines, automatic means for said link circuit for preventing more than one link circuit from being operatively connected to a subscriber's line at the same time, automatic ringing means for said link circuit, an answering and a calling supervisory signal for said link circuit, automatic means including a double-wound relay for flashing said answering signal, said double-wound relay controlling the operation of said automatic ringing means, automatic means including a second double-wound relay for flashing said calling signal, said first automatic means controlling contacts in the circuits of said double wound relays, a third relay, and a circuit for said relays controlled by said third relay.

16. A telephone system including a pair of subscribers' telephone lines, a circuit for connecting said lines, an answering and a calling supervisory signal for said circuit, circuits for said signals, a double-wound recall relay for connecting a circuit interrupter to said answering signal, a second double-wound recall relay for connecting said circuit interrupter to said calling signal, energizing circuits for said recall relays, an operator's telephone, electromag-

netic means controllable by an operator when answering a recall from either of said lines for automatically connecting said operator's telephone to said circuit, and electromagnetic means for preventing more than one operator from being connected in conversational circuit with the same subscriber's line at the same time, said last means controlling contacts in said energizing circuits of said recall relays and also a contact in the circuit of said answering supervisory signal.

17. A telephone system including a pair of subscribers' telephone lines, a link circuit for connecting said lines, other link circuits, and automatic means for preventing connection at one time of more than one of said link circuits to a calling one of said telephone lines, an answering and a calling supervisory signal for said circuit, a double-wound recall relay for connecting a circuit interrupter to said answering signal, said double-wound relay controlled over a circuit primarily controlled by said automatic means, a second double-wound recall relay for connecting said circuit interrupter to said calling signal, a third relay, contacts controllable by said third relay controlling the circuits of said first and second relays.

18. A telephone system including a pair of lines, a circuit for connecting said lines, a pair of signals associated with said circuit, a source of interrupter current, a double-wound relay for connecting said source of current to one of said signals, said relay being provided with an operating winding and a locking winding, and a second double-wound relay for connecting said source of current to the other of said signals, said last relay being provided with an operating winding and a locking winding, said second double-wound relay being inoperative until the first of said relays is operated.

19. A telephone system including a pair of subscribers' telephone lines, a link circuit provided with answering and calling terminals for connecting said lines, an operator's telephone, automatic electromagnetic means for connecting and disconnecting said operator's telephone and said link circuit, an answering and a calling supervisory signal for said link circuit, a recall relay for connecting a circuit interrupter to said answering signal, a second relay for connecting said circuit interrupter to said calling signal, a third relay having a circuit including a contact of one of said terminals, contacts controllable by said third relay controlling circuits for said first and second relays, and a locking circuit for each of said first and second relays, said automatic electromagnetic means controlling the initial operation of said recall relay, and also controlling the circuit of said answering signal.

20. A telephone system including a pair

- of subscribers' telephone lines, a link circuit provided with an answering terminal and calling terminal for connecting said lines, automatic ringing means for said link circuit, an answering supervisory signal and a calling supervisory signal for said link circuit, a source of interrupter current, a relay for connecting said source to said first signal, said relay also controlling the application of ringing current to a called line by said automatic ringing means, a relay for connecting said source of current to said second signal, circuits for said relays controllable by a third relay, a locking circuit for each of said first and second relays, an operator's telephone, and operator-controlled electromagnetic means for connecting the operator's telephone to the link circuit when answering a recall.
21. A telephone system including a pair of subscribers' telephone lines, a link circuit provided with an answering terminal and a calling terminal for connecting said lines, an operator's telephone for said link circuit but normally disconnecting therefrom, automatic electromagnetic means for connecting and disconnecting said operator's telephone and said link circuit, an answering supervisory signal and a calling supervisory signal for said link circuit, a source of interrupter current, a relay for connecting said source to said first signal, a relay for connecting said source of current to said second signal, and automatic ringing means for signaling the called one of said subscribers, said automatic ringing means controlled by said first relay for disconnecting said ringing means from the called line should the calling subscriber abandon the call before answered.
22. A telephone system including a calling and a called subscriber's line, a link circuit for connecting said lines, an operator's telephone for said link circuit but normally disconnected therefrom, automatic electromagnetic means for connecting and disconnecting said operator's telephone and said link circuit, automatic ringing means for said link circuit for signaling the called one of said subscribers, an answering supervisory signal, means controlled by the calling subscriber for automatically flashing said signal, said means also operative to disconnect said ringing means from said link circuit should the calling subscriber abandon the call prior to a response by the called subscriber, a calling supervisory signal, and means controlled by the called subscriber for automatically flashing said calling signal.
23. A telephone system including a calling and a called subscriber's line, a link circuit for connecting said lines, automatic ringing means for said link circuit for signaling the called one of said subscribers, an answering supervisory signal, means controlled by the calling subscriber for automatically flashing said signal, a calling supervisory signal, and means controlled by the called subscriber for automatically flashing said calling signal, said last means being ineffective until a control is exercised by the calling subscriber, said automatic ringing means operative over a circuit including contacts of said second means and said last means so that ringing current may be disconnected from said link circuit by the calling or the called subscriber.
24. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines, automatic ringing means for said link circuit, operator-controlled means for associating said ringing means with the called subscriber's line, calling subscriber-controlled means for disassociating said ringing means from said called subscriber's line, a signal for said link circuit, a supervisory relay for said link circuit controlled by said calling subscriber, a supervisory relay for said link circuit controllable by said called subscriber, means for automatically flashing said signal, said means being controllable by both of said supervisory relays, the said supervisory signal rendered effective to automatically flash only when said calling subscriber control means are operated to disassociate said ringing means from said calling subscriber's line or to signal for a disconnection or a recall.
25. A telephone exchange system including telephone lines extending from substations to an exchange, link connectors for connecting said lines, automatic electromagnetic means individual to said link connectors for preventing more than one link connector from being operatively connected to the same telephone line at the same time, apparatus at said substations for signaling an exchange operator and having normal and abnormal conditions for said apparatus, a visual signal device individual to each of said link connectors, means to cause said device to indicate a recall or a disconnect; means, operative during the time a link connector remains connected to a calling and a called line whereby a single change from abnormal to normal condition of said apparatus at a substation of said called line operates said device to indicate a disconnect and the subsequent single change from normal to abnormal condition of said apparatus operates said device to indicate a recall and means whereby a single change from abnormal to normal condition of said apparatus at the calling substation may also operate said device to indicate a disconnect.
26. A telephone exchange system including telephone lines extending from substations to an exchange, link connectors for connecting said lines, automatic electromagnetic means individual to said link connectors for preventing more than one link connector from being operatively connected to the same telephone line at the same time, apparatus at said substations for signaling an exchange operator and having normal and abnormal conditions for said apparatus, a visual signal device individual to each of said link connectors, means to cause said device to indicate a recall or a disconnect; means, operative during the time a link connector remains connected to a calling and a called line whereby a single change from abnormal to normal condition of said apparatus at a substation of said called line operates said device to indicate a disconnect and the subsequent single change from normal to abnormal condition of said apparatus operates said device to indicate a recall and means whereby a single change from abnormal to normal condition of said apparatus at the calling substation may also operate said device to indicate a disconnect.

tions to an exchange, link connectors for connecting said lines, automatic electromagnetic means individual to said link connectors for preventing more than one link connector from being operatively connected to the same telephone line at the same time, apparatus at said substations for signaling an exchange operator and having normal and abnormal conditions for said apparatus, a recall signal circuit, a supervisory relay and two other relays for each of said link connectors; means, operative during the time a link connector is connected to a called line, whereby a change from normal to abnormal condition of said apparatus at a substation of said line energizes said supervisory relay, thereby energizing one of said other relays; means other than said supervisory relay, for thereafter maintaining said relay energized during said connection; means, whereby the subsequent change from abnormal to normal conditions of said apparatus de-energizes said supervisory relay and by means of said other relay energizes the third of said relays; means, other than said supervisory relay, for thereafter maintaining said third relay energized during said connection; means, including said third mentioned relay, whereby the re-energization of said supervisory relay by the subsequent change from normal to abnormal condition of said apparatus closes said recall signal circuit; and manually operated exchange means, whereby said second and third mentioned relays may be de-energized during an established connection with said link connector, thereby opening said recall signal circuit.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 27th day of June, 1918.

CHARLES SPARKS.