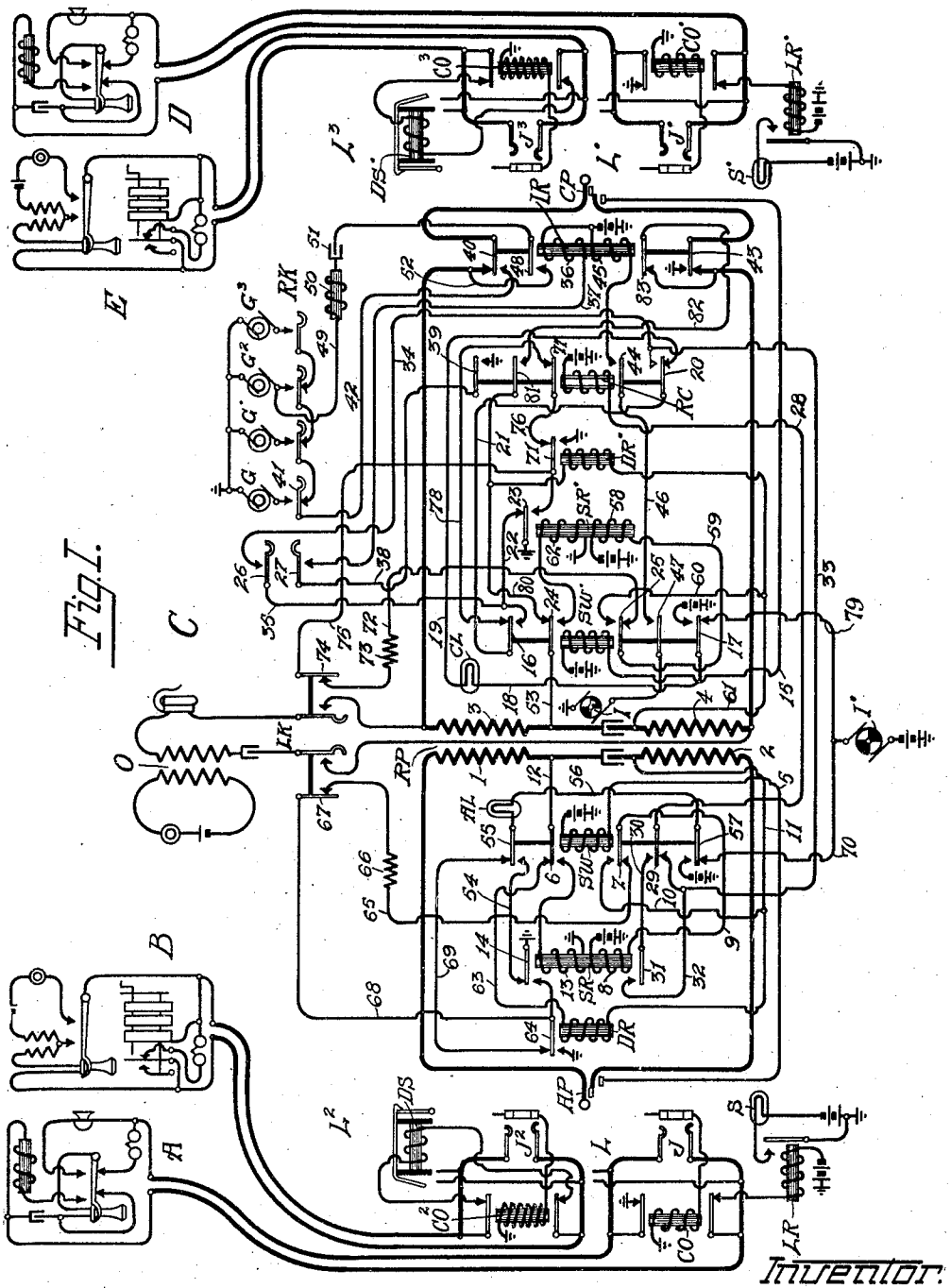
Dec. 26, 1922. 1,440,114

C. SPARKS.
TELEPHONE SYSTEM.
ORIGINAL FILED AUG. 5, 1918. 2 SHEETS-SHEET 1



Inventor:
Charles Sparks.
By Curtis B. Camp
Attorney.

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C. SPARKS.
TELEPHONE SYSTEM.
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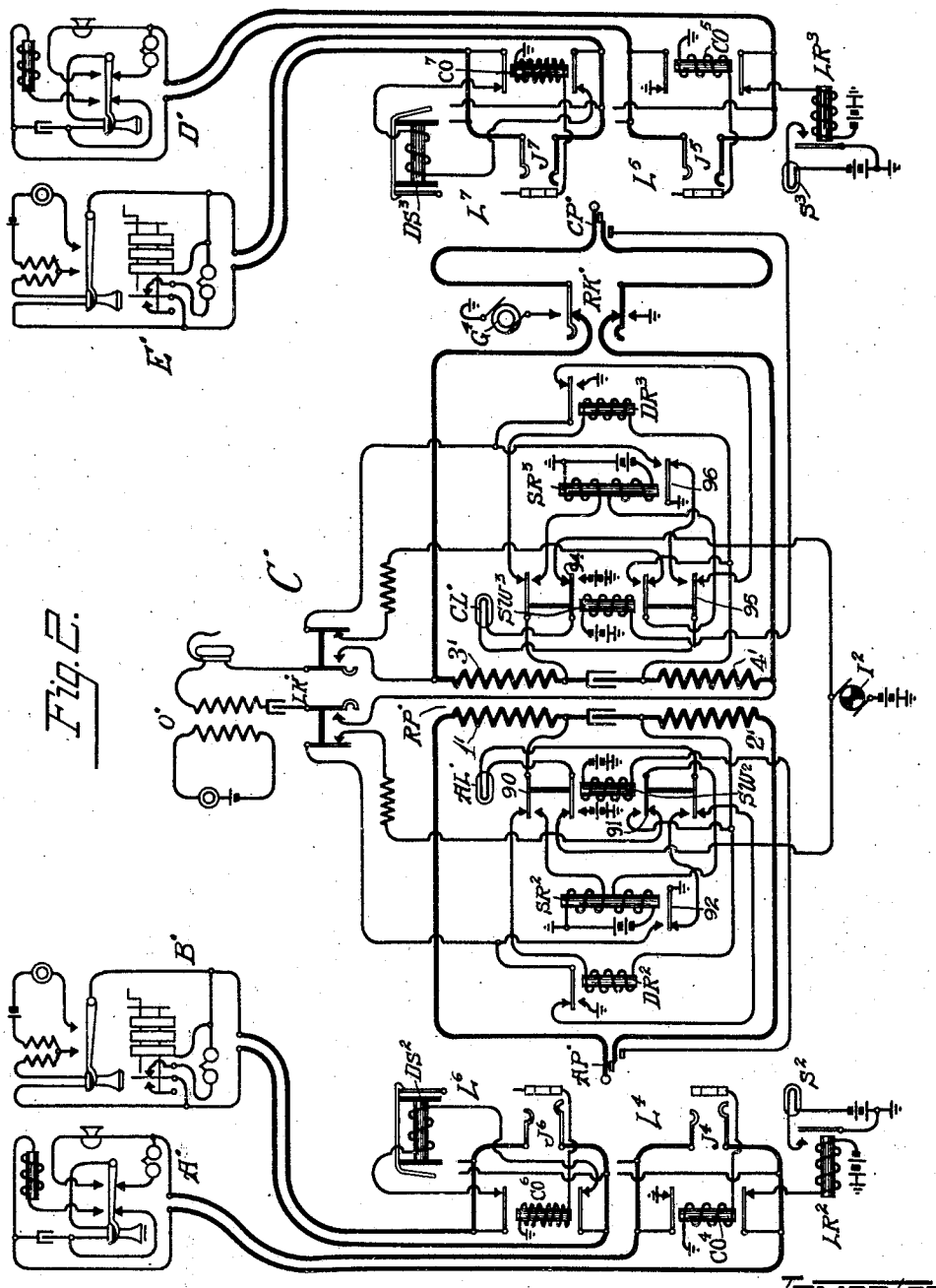

Fig. 2.

Inventor:
Charles Sparks.
By Curtis B Camp
Attorney

Patented Dec. 26, 1922. 1,440,114

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 August 5, 1918, Serial No. 248,281. Renewed August 11, 1922. Serial No. 581,263.

To all whom it may concern:

Be it known that I, CHARLES SPARKS, a citizen of the United States of America, residing in 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 interconnecting telephone lines of different character, such as common battery and local battery lines.

A feature of my invention is the provision of means whereby when a common battery subscriber has terminated conversation the usual supervisory signal is lighted to notify the operator that disconnection is desired, and whereby when a local battery subscriber has terminated conversation the disconnect signal sent by the subscriber operates means to cause the supervisory signal to flash intermittently, independently of the disconnect signal sent by the subscriber.

Another feature of my invention is the provision of means whereby as long as the subscriber is ringing in on a local battery line the flash disconnect apparatus is rendered inoperative to flash the supervisory lamp.

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 a telephone system, and in which:

Fig. 1 illustrates one form of my invention operating in connection with a universal cord circuit in which automatic ringing is provided; and

Fig. 2 illustrates my invention operating in connection with a universal cord circuit in which manual ringing only is provided.

Referring now more particularly to Fig. 1, 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. To the left of the drawing, I show a calling common battery substation A and a calling local battery substation B, and to the right of the drawing I show a called common battery substation D and a called local battery substation E. The common battery substations A and D terminate respectively at the exchange in line circuits L and L′, with the usual line relays LR and LR′, cut-off relays CO and CO′, line signals S and S′, and multiple jacks J and J′. The local battery substations B and E terminate respectively at the exchange in line circuits L^2 and L^3, which line circuits comprise the high resistance wound cut-off relays CO^2 and CO^3, multiple jacks J^2 and J^3, 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 windings 1, 2, 3 and 4. The answering end of the cord circuit C comprises a switching relay SW, 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 a 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 SR is provided which is actuated over the line when a connection is made with a 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. An answering supervisory lamp AL is also associated with the answering end of the cord circuit C for the usual supervisory purposes. 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, a switching relay SW′, a supervisory relay SR′, and a disconnect relay DR′. In addition, I provide a party line ringing key RK for connecting one of a plurality of ringing generators G, G′, G^2 and G^3 to signal the subscriber at a called for common battery 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 and remains energized until the called subscriber answers in response to the signal.

An interrupter relay IR is also provided which is energized upon the actuation of the ringing key RK 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 to intermittently energize and deenergize the relay IR to intermittently connect ringing current to the called line. To signal a local battery substation, the operator must depress one of the ringing plungers to connect current to the called line each time the substation bell is to be operated. A calling supervisory lamp CL is also provided for the usual supervisory purposes. A listening key LK is provided for connecting the operator's set O to the conductors to inquire the wants of the subscribers. I also provide an interrupter I' for flashing the supervisory signals AL and CL when disconnection is desired, as will be more fully hereinafter described.

Referring now in general to Fig. 2, I show a universal cord circuit C' also adapted to connect lines of different character, such as common battery and local lines, common battery and common battery lines, or local battery and local battery lines. To the left of the drawing, I show a common battery substation A' and local battery substation B', and to the right of the drawing I show a common battery substation D' and a local battery substation E'. The common battery substations A' and D' terminate respectively at the exchange in line circuits L^4 and L^5, which comprise the usual line relays LR^2 and LR^3, cut-off relays CO^4 and CO^5, line signals S^2 and S^3, and multiple jacks J^4 and J^5. The local battery substations B' and E' terminate respectively at the exchange in line circuits L^6 and L^7, which line circuits comprise the high resistance cut-off relays CO^6 and CO^7, multiple jacks J^6 and J^7, and drop signals DS^2 and DS^3.

The 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 windings 1', 2', 3' and 4'. The answering end of the cord circuit C' comprises a switching relay SW^2, a supervisory relay SR^2 and a disconnect relay DR^2. The calling end of the cord circuit C' comprises a switching relay SW^3, a supervisory relay SR^3 and a disconnect relay DR^3, the said relays operating in a similar manner to that described in connection with Fig. 1. Answering and calling supervisory lamps AL' and CL' are provided for the usual supervisory purposes. The cord circuit C' is also provided with manual ringing, and for this purpose I provide a ringing key RK' which, when actuated, connects ringing generator G^4 to the line. An interrupter I^2 is also provided for causing the supervisory lamps AL' and CL' to flash when a local battery subscriber transmits his disconnect signal. A listening key LK' is also provided which, when actuated, connects the operator's set O' to the cord conductors to inquire the wants of a calling subscriber.

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 systems as illustrated.

Operation of cord circuit of Fig. 1.

Referring now more particularly to Fig. 1, and assuming that the common battery subscriber at substation A initiates a call, the removal of the receiver thereat establishes an energizing circuit for the line relay LR, which relay, upon energization, brings about the lighting of the line signal S. The operator, noting the lighted signal S actuates 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 J of the calling line. A series energizing circuit is established for the cut-off relay CO of the line circuit L and the switching relay SW of the cord circuit C, the said circuit being traced from battery through the winding of the switching relay SW, over conductor 5, through sleeve contacts of the connected plug AP and jack J, and through the winding of the cut-off relay CO to ground. The cut-off relay CO, upon energizing, opens the circuit of the relay LR, which relay restores and effaces the line signal S. The closing of alternate contacts 6 and 7 of the switching relay SW establishes an energizing circuit for the supervisory relay SR, traced from battery through the lower winding 8 of relay SR, conductor 9, alternate contact 7 of relay SW, conductor 10, conductor 11, winding 2 of the repeating coil RP, ring contacts of the connected plug AP and jack J, through the now closed contacts of the substation switch hook, back over the tip contacts of the connected jack J and plug AP, winding 1 of the repeating coil RP, conductor 12, alternate contact 6 of relay SW, and through the winding 13 of the supervisory relay SR to ground. The opening of normal contact 14 of the supervisory relay SR prevents the premature lighting of the answering supervisory lamp AL.

Common battery to common battery.

The operator now inquires the wants of the calling subscriber at the common battery substation A, and assuming that it is the subscriber at the common battery substation B that is wanted, the operator tests the mul-

tiple jack J′ of the called line in the usual manner, and assuming that the line is idle, she inserts the calling plug CP into the jack J′ of the called line and this insertion of plug CP into jack J′ closes a series energizing circuit for the cut-off relay CO′ of the line circuit L′ and the switching relay SW′ of the cord circuit C, traced from battery through the winding of the switching relay SW′, conductor 15, sleeve contacts of the connected plug CP and jack J′, and through the winding of the cut-off relay CO′ to ground. The closing of alternate contacts 16 and 17 of the switching relay SW′ establishes an energizing circuit for the calling supervisory lamp CL, traced from battery through the alternate contacts 17, conductor 18, through the lamp CL, conductor 19, normal contact 20 of the ringing control relay RC, conductor 21, alternate contact 16 of the relay SW′, conductor 22 to ground at normal contact 23 of supervisory relay SR′, the said supervisory lamp CL remaining lighted until the operator actuates the ringing key RK. The closing of alternate contacts 24 and 25 connects the supervisory relay SR′ to the cord conductors, but due to the open switch hook contacts at the called substation B, the said relay SR′ remains at normal until the called subscriber answers.

The operator next depresses the proper ringing key plunger of the ringing key RK to its fully depressed position, which moves the end springs 26 and 27 of the ringing key RK to their alternate position, and connects the proper ringing generator G, G′, G^2 or G^3 to signal the called for subscriber at substation B. The closing of alternate contact 26 of the end springs establishes an energizing circuit for the ringing control relay RC, traced from battery through the winding of the said relay RC, conductor 28, alternate contact 29 of relay SW, conductor 30, alternate contact 31 of relay SR, conductor 32, conductor 33, conductor 34, alternate contact 26 of the end springs, conductor 35 and conductor 22, to ground at normal contact 23 of relay SR′. The relay RC, upon energizing, then closes a locking circuit for itself, traced from battery through the winding of relay RC, conductor 28, alternate contact 29 of relay SW, conductor 30, alternate contact 31 of relay SW, conductors 32 and 33, alternate contact 20 of the ringing control relay RC, conductor 21, alternate contact 16 of relay SW′, and conductor 22 to ground at normal contact 23 of relay SR′. The interrupter relay IR is also energized during the interval that the plunger of the ringing key RK is held down over a circuit traced from battery through the upper winding 36 of the relay IR, conductor 37, alternate contact 27 of the end springs, and conductor 38, to ground at alternate contact 39 of relay RC. The closing of alternate contact 40 of relay IR connects ringing current from the generator G, which we will assume is the selected ringing generator, to the called line from the ungrounded pole of the generator G, alternate contact 41 of the ringing key plunger, conductor 42, alternate contact 40 of relay IR, tip contacts of the connected plug CP and jack J′, through the condenser and call bell of the called substation D, back through the ring contacts of the connected plug CP and jack J′, to ground at alternate contact 43 of relay IR. This connection of ringing current, immediately upon the depression of a ringing key plunger of ring key RK, gives an instantaneous first ring of the called subscriber's call bell. The opening of normal contact 20 of relay RC effaces the calling supervisory signal CL. The closing of alternate contact 44 of relay RC connects the interrupter I to the lower winding 45 of the interrupter relay IR, the circuit being traced from battery through the winding 45 of the relay IR, alternate contact 44 of relay RC, conductor 46, through alternate contact 47 of relay SW′, and through the constantly rotating interrupter I to ground. The relay IR is thus intermittently energized and de-energized to connect ringing current from the generator G to the called line over a circuit traced from the ungrounded pole of the generator G, through alternate contact 41 of the ringing key plunger contact, conductor 42, alternate contact 40 of relay IR, tip contacts of the connected plug CP and jack J′, through the condenser and call bell at the called subscriber's substation D, back through ring contacts of the connected jack J′ and plug CP, to ground at alternate contact 43 of relay IR. The closing of alternate contact 48 of relay IR transmits an audible tone to the calling subscriber at the substation A, traced over a circuit extending from the ungrounded pole of the generator G^2, over conductor 49, through resistance 50, condenser 51, alternate contact 48 of relay IR, conductor 52, tip conductor of the cord circuit C, winding 3 of the repeating coil RP, conductor 53, alternate contact 24 of relay SW′, through the upper winding of relay SR′ to ground. The ringing tone is induced in the other winding of the repeating coil RP and transmitted to the calling subscriber at substation A, giving the subscriber thereat an audible signal notifying him that the called subscriber is being signalled. The called subscriber at substation D is thus automatically signalled until the subscriber thereat answers in response to his call signal or until the calling subscriber replaces his receiver. Should the calling subscriber replace his receiver before the called subscriber at substation D answers, the replacing of the receiver thereat opens the circuit of the supervisory relay SR at the

switch hook contacts, and the relay SR, upon de-energizing, opens its alternate contact 31 to open the locking circuit of the ringing control relay RC. The relay RC, upon de-energizing, opens its alternate contact 44, disconnecting the interrupter I from the winding 45 of the relay IR, which relay de-energizes and opens its alternate contact 40, thus preventing further application of ringing current. The relay SR restoring closes its normal contact 14, closing a circuit for the answering supervisory lamp AL, traced from ground at normal contact 14, over conductor 54, through alternate contact 55 of relay SW, through the lamp AL, and conductor 56 to battery and ground at alternate contact 57 of relay SW. The closing of normal contact 20 of relay RC, upon its restoration, closes a circuit for the calling supervisory lamp CL, traced from ground at normal contact 23 of relay SR', conductor 22, alternate contact 16 of relay SW', conductor 21, normal contact 20 of relay RC, conductor 19, through the lamp CL, and conductor 18 to battery and ground at alternate contact 17 of the relay SW'. The operator noting the two lighted signals AL and CL knows that the calling subscriber has replaced his receiver and now withdraws the answering and calling plugs AP and CP from their respective jacks J and J', opening the series circuits for the relays CO and SW, and CO' and SW'. The relays SW and SW' restoring, place the apparatus of the cord circuit C at normal, and the said cord is now available for establishing other connections.

The subscriber at the called substation D in response to his call signal, removes his receiver from its switch hook, and when the relay IR is in one of its de-energized positions an energizing circuit for the supervisory relay SR' is established, traced from battery through the lower winding 58 of relay SR', over conductor 59, through alternate contact 25 of relay SW', conductor 60, conductor 61, winding 4 of the repeating coil RP, normal contact 43 of relay IR, 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 40 of relay IR, winding 3 of the repeating coil RP, conductor 53, alternate contact 24 of relay SW', and through the winding 62 of the supervisory relay SR' to ground.

The opening of normal contact 22 of the supervisory relay SR' opens the locking circuit of the ringing control relay RC, and the said relay RC restores, opening its alternate contact 44, disconnecting the interrupter I from the winding 45 of the relay IR, which allows relay IR to remain at normal. The opening of alternate contact 40 of the relay IR prevents further application of ringing current from the generator G to the called subscriber who has now answered his call in response to his call signal. The calling and called subscribers at the substations A and D are now in conversational circuit, the talking circuit being traced over the heavily marked conductors.

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 supervisory relay SR causes its normal contact 14 to close, establishing an energizing circuit for the answering supervisory lamp AL, traced from ground at normal contact 14, over conductor 54, through alternate contact 55 of relay SW, through the lamp AL, and conductor 56 to battery and ground at alternate contact 57 of relay SW. The restoration of the supervisory relay SR' causes its normal contact 23 to close, establishing an energizing circuit for the calling supervisory lamp CL, traced from battery at alternate contact 17 of relay SW', over conductor 18, through the lamp CL, conductor 19, normal contact 20 of relay RC, conductor 21, alternate contact 16 of relay SW', and conductor 22 to ground at normal contact 23 of relay SR'. The operator noting the two lighted signals knows the conversation has been terminated and withdraws the answering and calling plugs AP and CP from their respective jacks J and J', allowing the switching relays SW and SW' to restore, placing the apparatus of cord circuit C at normal ready for establishing other connections. The cut-off relays CO and CO' also restore to normal when the plugs AP and CP are withdrawn, placing the line circuits L and L' at normal.

Local battery to local battery—Fig. 1.

Assuming now that the local battery substation B initiates a call, the actuation of the hand generator by the subscriber brings about the operation of the drop signal DS, and the operator noting the actuated drop signal DS inserts the answering plug AP of cord circuit C into the jack J^2 of the calling line. The insertion of the plug AP into the jack J^2 restores the drop signal DS and establishes a series energizing circuit for the cut-off relay CO^2 and the switching relay SW of the cord circuit C. This circuit is traced from battery through the winding of relay SW, over conductor 5, through sleeve contacts of the connected plug AP and jack J^2, and through the winding of the high resistance cut-off relay CO^2 to ground. The cut-off relay CO^2 energizes, but due to the high resistance of the said cut-off relay CO^2 of the local battery line circuit L^2, 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 to the cord conductors and inquires the wants of the calling subscriber at the local battery substation B. Assuming that it is the local battery substation E that is wanted, the operator tests the line in the usual manner, and finding it idle, the operator inserts the calling plug CP into the jack J^3 of the wanted line. A series circuit is established for the cut-off relay CO^3 of the local battery line circuit L^3, and the switching relay SW' of the cord circuit C, traced from battery through the winding of the relay SW', over conductor 15, through contacts of the connected plug CP and jack J^3, and through the winding of the relay CO^3 to ground. The switching relay SW' does not operate, due to the high resistance of relay CO^3 and remains at normal, but the relay CO^3 energizes. The operator now actuates one of the ringing key plungers of the ringing key RK, and assuming that it is the generator G which is to be connected, the depression of the plunger to its fully depressed position also actuates the end springs 26 and 27.

The closing of contact 26 of the end springs establishes an energizing circuit for the ringing control relay RC, traced from battery through the winding of the relay RC, conductor 28, normal contact 29 of relay SW, conductors 33 and 34, alternate contact 26, conductor 35, and conductor 22, to ground at normal contact 23 of relay SR'. The closing of alternate contact 39 of relay RC establishes an energizing circuit for the interrupter relay IR, traced from battery through the winding 36 of relay IR, conductor 37, alternate contact 27, and conductor 38, to ground at alternate contact 39. The closing of alternate contact 40 of relay IR connects ringing current from genereator G, through alternate contact 41 of the depressed key plunger of ringing key RK, conductor 42, alternate contact 40 of relay IR, tip contacts of the plug CP and jack J^3, through the call bell of the called substation E, back through the ring contacts of the jack J^3 and plug CP, to ground at alternate contact 43 of relay IR. There is no locking circuit established for the relay RC, due to the switching relay SW remaining at normal, and for each application of ringing current the operator must depress the ringing key plunger. The locking circuit of the relay RC extends through alternate contacts of the switching relay SW', and as the switching relay SW' is at normal during the connection of the calling end of the cord circuit C to the local battery line E, the relay RC does not lock up. Relay SW' remaining at normal also prevents the interrupter I from being connected with the interrupter relay IR. The operator thus rings the call bell at the substation E until the called subscriber thereat answers. Assuming that the called subscriber at substation E has answered, the conversational circuit may be traced over the heavily marked conductors.

Assuming that the subscribers at the calling and called substations B and E have finished conversation, the subscribers thereat restore their receivers upon their respective switch hooks and actuate their hand generators to signal the operator of the cord circuit C. The subscriber at substation B having actuated his hand generator, current will pass through the disconnect relay DR of the cord circuit C over a circuit traced from the hand generator at the substation B, over the tip side of the line, through the tip contacts of the jack J^2 and plug AP, winding 1 of the repeating coil RP, conductor 12, normal contact 6 of relay SW, conductor 63, through the winding of the disconnect relay DR, conductor 11, winding 2 of the repeating coil RP, ring contacts of the plug AP and jack J^2, and back to the generator at the substation B. When current passes through the disconnect relay, it is energized and closes its alternate contact 64, bringing about the energization of the supervisory relay SR, over a circuit traced from battery through the winding 8 of the relay SR, conductor 9, normal contact 7 of switching relay SW, conductor 65, resistance 66, normal contact 67 of listening key LK, and conductor 68 to ground at alternate contact 64 of the relay DR. The relay SR, upon energizing, closes a locking circuit for itself, traced from battery through the winding 8 of the relay SR, conductor 9, normal contact 7 of relay SW, conductor 65, resistance 66, normal contact 67 and conductor 68, to ground at alternate contact 14 of relay SR. When the subscriber at the calling substation B has ceased actuating his hand generator, relay DR restores to normal, and closes a circuit for the answering supervisory lamp AL, traced from ground at alternate contact 14 of relay SR, through normal contact 64 of relay DR, over conductor 69, through normal contact 55 of relay SW, conductor 56, normal contact 57, conductor 70, and through the constantly rotating interrupter I' to battery and ground. The supervisory lamp AL is thus flashed, due to the interrupter I', giving the operator of the cord circuit C a flashing disconnect signal, or if the code signals have been arranged, the subscriber at the substation B may actuate his hand generator according to a predetermined code and notify the operator of the cord circuit C whether the flashing signal is either a disconnect signal or a recall signal. During the actuation of the hand generator at the calling substation B, the current passes through the relay DR and is thus held energized, and its normal contact 64 remains open during this pe-

riod, preventing the interrupter circuit through the lamp AL from being closed. Thus the flashing is started only after the current from the hand generator through the relay DR has ceased. The operator noting the flashing signal actuates her listening key LK, should the flashing signal be a recall, and interrupts the normal contact 67 of listening key LK, thereby opening the locking circuit of the relay SR, which relay deenergizes and opens its alternate contact 14, interrupting the flashing circuit of the lamp AL to prevent further flashing of the signal.

The subscriber at the local battery substation E now actuates his hand generator after finishing conversation, and the current from his hand generator actuates the disconnect relay DR′, as is apparent from the previous description in connection with relay DR. The closing of alternate contact 71 of the relay DR′ establishes an energizing circuit for the supervisory relay SR′ traced from battery through the lower winding 58 of relay SR′, conductor 59, normal contact 25 of relay SW′, conductor 72, resistance 73, normal contact 74 of listening key LK, and conductor 75 to ground at alternate contact 71 of relay DR′. The relay SR′ now closes a locking circuit for itself traced from battery through winding 58 of relay SR′, conductor 59, normal contact 25, conductor 72, resistance 73, normal contact 74, and conductor 75 to ground at alternate contact 23 of relay SR′. While the called subscriber at the local substation E is sending the disconnect signal, the calling supervisory lamp is prevented from flashing for the reason previously described in connection with the supervisory lamp AL. When the subscriber at the substation E has finished sending a disconnect signal, the relay DR′ restores to normal, and the closing of normal contact 71 closes a circuit for the calling supervisory lamp CL, traced from ground at alternate contact 23 of relay SR′, through normal contact 71 of relay DR′, conductor 76, normal contact 77 of relay RC, conductor 78, normal contact 16 of relay SW′, conductor 21, normal contact 20 of relay RC, conductor 19, through the lamp CL, conductor 18, normal contact 17 of relay SW, conductor 79, and through the interrupter I′ to battery and ground. The calling supervisory lamp CL is caused to flash due to the constantly rotating interrupter I′ to give the operator a flashing disconnect signal, or in case of a code signal to signal the operator for a recall. The operator noting the two flashing disconnect signals of lamps AL and CL knows the conversation has terminated and now actuates her listening key LK to interrupt contacts 67 and 74 to open the locking circuits of relays SR and SR′, allowing the relays to restore. The opening of alternate contacts 14 and 23 of relays SR and SR′ opens the circuit of the flashing supervisory signals AL and CL, and thus prevents further flashing of the signals. The operator now withdraws the answering and calling plugs AP and CP from their respective jacks J^2 and J^3, allowing the relays CO^2 and CO^3 to restore. The apparatus of cord circuit C and line circuits L^2 and L^3 are now at normal and available for establishing other connections.

When a local battery line is signaled, the discharge of the line might bring up the relay DR′ and close a circuit for the relay SR′, which would lock up and cause the signal CL to flash and give a false disconnect if some means were not provided to guard against this. To overcome this, I provide a short circuit for the relay DR′, as will now be described. After each application of ringing current, a discharge from the line is sent back through the tip of the plug, through normal contact 40, through winding 3 of the repeating coil RP, over conductor 53, normal contact 24 of relay SW′, over conductor 80, through alternate contact 81 of relay RC, which relay being slow to release holds up momentarily after each application of ringing current, over conductor 82, through normal contact 83 of relay IR, to the ring conductor of the cord circuit C. This path for the line discharge places a short circuit about the disconnect relay DR′ and prevents the line discharge from affecting the relay DR. The relay DR′ thus remains normal, thereby preventing the giving of a false disconnect signal.

Common battery to local battery.

Should a calling common battery subscriber at the substation A wish to converse with the local battery subscriber at the substation E, the insertion of the plug AP into the jack J brings about the energization of the switching relay SW and the cut-off relay CO, and the closing of alternate contacts 6 and 7 of relay SW brings about the actuation of the supervisory relay SR over the line. The operator in inserting the calling plug CP into the jack J^3 of the local battery line E brings about the energization of the relay CO^3 through the switching relay SW′, but the switching relay SW′ does not operate when connected to the local battery line for reasons as previously stated. The supervisory signal AL is brought into play as a disconnect signal when the calling common battery subscriber A hangs up, and the flashing of calling supervisory lamp CL as a disconnect signal, when the local battery subscriber at substation E sends a disconnect signal, is readily apparent from the previous description.

Local battery to common battery.

The subscriber at the local battery sub-

station B when calling actuates his drop signal DS, and the operator in response thereto inserts the answering plug AP into the jack J^2. In this instance, the cut-off relay CO^2 actuates, but the switching relay SW does not operate for reasons as already described. The common battery subscriber at substation D being wanted, the operator inserts the plug CP in the jack J' of the called line and closes a series circuit for relays SW' and CO', both relays operating. The operator now depresses the proper ringing key plunger to bring about the actuation of relay RC and connect ringing current to the called line. The circuit for relay RC is traced in this instance from battery through the winding of the relay RC, conductor 28, normal contact 29, conductor 33, conductor 34, alternate contact 26, and conductor 35 to ground at normal contact 23 of relay SR'. The relay RC has a locking circuit established through its alternate contact 20 and contact 29 of relay SW, and from this point on the operation is the same as previously described, including the disconnect signal of the calling local battery subscriber at substation B, and that of the common battery subscriber at substation D.

Operation of Fig. 2.

In Fig. 2, I show a cord circuit C', in the form of a universal cord circuit, and in which the operation is similar to that described in connection with Fig. 1, but in the cord circuit as illustrated in Fig. 2, I show manual ringing equipment for signaling the local battery and common battery called subscribers.

Assuming now that a common battery subscriber at the substation A', initiates a call, the removal of the receiver thereat causes the operation of the line relay LR^2, which relay brings about the lighting of the line signal S^2. The operator inserts the plug AP' in the jack J^4 of the line and closes a series circuit for the cut-off relay CO^4 and the switching relay SW^2, as described in connection with Fig. 1. The switching relay SW^2, upon energization, closes its alternate contacts 90 and 91 to connect the supervisory relay SR^2 to the line conductors, the said relay operating over the line, and the opening of its normal contact 92 prevents the premature lighting of the answering supervisory signal AL'. The operator actuates her listening key LK' and connects her operator's set O' to the cord conductors. Assuming that it is the common battery substation D' that is wanted, she tests the line, and assuming it is idle, she inserts the plug CP' into the jack J^5 of the wanted line. This insertion of plug CP' into the jack J^5 closes a series circuit for the relays CO^5 and SW^3, which relays operate as is apparent from the previous description. The calling supervisory lamp CL' in this case remains lighted until the called subscriber answers, the circuit being traced from battery at alternate contact 94 of relay SW^3, through the lamp CL', alternate contact 95 of relay SW^3, to ground at normal contact 96 of supervisory relay SR^3. The operator now actuates the ringing key RK' to connect ringing generator G^4 to the called line to ring the call bell of the called subscriber at the substation D'. The operator actuates the key to connect generator G^4 for each application of ringing current, and when the subscriber at substation D' answers, a circuit for the supervisory relay SR^3 is closed over the line, and the opening of normal contact 96 of relay SR^3 effaces the calling supervisory signal CL', notifying the operator that the called subscriber at substation D' has answered. The subscribers are now in conversational circuit, and the talking circuit may be traced over the heavily marked conductors. Assuming conversation has terminated, the subscribers at the substations A' and D' replace their receivers upon their respective switch hooks, opening the circuits of the supervisory relays SR^2 and SR^3, and the closing of normal contacts 92 and 96 of relays SR^2 and SR^3 closes energizing circuits for the answering and calling supervisory lamps AL' and CL'. The lamps glowing notify the operator that the conversation is finished, and she now withdraws plugs AP' and CP' from their respective jacks J^4 and J^5. The relays SW^2 and SW^3 restore, as do the cut-off relays SO^4 and CO^5, and the apparatus is now at normal and available for other connections.

Assuming now that the local battery subscriber at substation B' initiates a call, the operation of the hand generator thereat operates the drop signal DS^2 at the exchange, and the operator inserts the plug AP' into the jack J^6, closing a series circuit for the high resistance cut-off relay CO^6 and the switching relay SW^2. The relay CO^6 operates, but the relay SW^2 remains at normal, as previously described in connection with Fig. 1. Assuming it is the subscriber at the local battery substation E' that is wanted, the plug CP' is inserted into the jack J^7 of the wanted line, closing a series circuit for the switching relay SW^3 and the high resistance cut-off relay CO^7. The relay CO^7 operates, but the switching relay SW^3 does not, and remains at normal due to the high resistance of relay CO^7. The operator actuates the ringing key RK' to connect ringing generator G^4 to the called line to operate the call signal at the called local battery substation E', and the signal is actuated until the subscriber thereat answers.

When conversation has terminated, the calling and called subscribers at substations

B′ and E′ replace their receivers upon their respective switch hooks and actuate their hand generators, and the current therefrom actuates the disconnect relays DR^2 and DR^3, which relays bring about energizing circuits for the supervisory relays SR^2 and SR^3, which relays close locking circuits for themselves, and when the subscribers have finished sending their disconnect signals, the relays DR^2 and DR^3 restore, closing circuits through the supervisory lamps AL′ and CL′ through the interrupter I^5. The operator noting the flashing disconnect signals of lamps AL′ and CL′ knows that conversation has terminated and actuates her listening key LK′ to open the locking circuits of supervisory relays SR^2 and SR^3, which relays restore and prevent further flashing of the lamps AL′ and CL′. The operator now withdraws plugs AP′ and CP′ from their respective jacks J^6 and J^7 to allow cut-off relays CO^6 and CO^7 to restore. The apparatus of the cord C′ and line circuits L^6 and L^7 is now at normal and available for establishing other connections.

Local battery lines and common battery lines may be interconnected, as may also common battery and local battery lines, all of which is apparent from the previous description.

While I have illustrated several forms of my invention, I do not wish to be limited to the same as various other arrangements may 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.

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

1. A telephone system including common battery and local battery telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, interrupter means for flashing said signal, a relay controlled over one of said local battery lines when the subscriber signals for disconnection for connecting said interrupter means in circuit with said signal thereby opening and closing the circuit of said signal causing the same to flash, and a relay for causing said signal to glow continuously when a common battery line signals for disconnection.

2. A telephone system including common battery and local battery telephone lines, a universal cord circuit for interconnecting said lines, a supervisory signal for said cord circuit, interrupter means for flashing said supervisory signal, a relay controlled over one of said local battery lines when the subscriber signals for disconnection for associating said interrupter means with said signal to flash the same, said interrupter means being ineffective to flash said signal as long as said relay is energized, and means for causing said signal to glow continuously when a common battery line signals for disconnection.

3. A telephone system including a local battery telephone line, and a common battery telephone line, a link circuit for connection to said lines, a signal for said link circuit, an interrupter device, means controlled over said local battery telephone line when the subscriber signals for disconnection for connecting said interrupter device in circuit with said signal thereby opening and closing the circuit of the same to cause the signal to be intermittently operated, and means controlled over said common battery line when the said link circuit is connected to said common battery line for causing said signal to glow continuously when disconnection is signalled for.

4. A telephone system including a local battery telephone line, a common battery line, a link circuit for connection to said lines, a signal for said link circuit, an interrupter device, means controlled over said local battery telephone line when the subscriber signals for disconnection for associating said interrupter device with said signal for flashing the same, said means being ineffective to flash said signal during the period said subscriber is operating his magneto, and means for causing said signal to glow continuously when a link circuit is connected to said common battery line, and said common battery subscriber signals for disconnection.

5. A telephone system including local battery and common battery telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, means controlled over one of said common battery lines for causing said supervisory signal to glow continuously, means controlled over one of said local battery lines for opening and closing the circuit of said supervisory signal causing the same to flash intermittently, and means adapted when operated to render said last means inoperative.

6. A telephone system including local battery and common battery telephone lines, a universal cord circuit for connecting said lines, a signal for said cord circuit, means controlled over a common battery line to cause said signal to glow continuously, interrupter means, and means controlled over a local battery line to connect said interrupter means in circuit with said signal to open and close the circuit thereof, thereby causing the signal to flash.

7. A telephone system including local battery and common battery telephone lines, a universal cord circuit for connecting said lines, a signal for said cord circuit, means controlled over a common battery line to cause said signal to glow continuously, in-

terrupter means, means controlled over a local battery line to connect said interrupter means in circuit with said signal to open and close the circuit thereof thereby causing the signal to glow intermittently, and operator controlled means for disassociating said interrupter means from said signal.

8. A telephone system including local battery and common battery telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, interrupter means, a relay for said cord circuit controllable over one of said common battery lines for causing said signal to glow continuously, and a relay for said cord circuit controllable over one of said local battery lines for connecting said interrupter means in circuit to open and close the circuit of said signal thereby causing the same to flash.

9. A telephone system including a local battery subscriber's telephone line, a common battery subscriber's line, a link circuit for connection to said lines, a supervisory signal, interrupter means, a relay controllable over said local battery subscriber's telephone line when said subscriber is signaling for disconnection for connecting said interrupter means in circuit with said supervisory signal to open and close the circuit thereof to cause the same to be flashed intermittently, and means for causing said signal to glow continuously when a link circuit is connected to said common battery subscriber's line and the subscriber signals for disconnection.

10. A telephone system including a local battery subscriber's telephone line, a common battery subscriber's line, a link circuit for connection to said lines, a supervisory signal, interrupter means, a relay controllable over said local battery subscriber's telephone line when said subscriber is signaling for disconnection for connecting said interrupter means in circuit with said supervisory signal to open and close the circuit thereof to cause the same to be flashed intermittently, operator controlled means for disconnecting said interrupter means from said supervisory signal, and a relay controlled over the common battery subscriber's line when the link circuit is connected to a common battery subscriber for causing said signal to glow continuously when the common battery subscriber signals for disconnection.

11. A telephone system including local battery and common battery telephone lines, a universal cord circuit for interconnecting said lines, an answering and a calling supervisory signal for said cord circuit, means controlled over said common battery lines for causing a continuous glow of said signals when disconnection is signaled for, and means controlled over said local battery lines for causing intermittent operation of said signals by the opening and closing of the circuit thereof when disconnection is signaled for, said last means including a source of current and an interrupter located at the exchange.

12. A telephone system including common battery and local battery telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, means controlled by one of said common battery subscribers for causing a continuous glow of said signal, an interrupter, and a relay controlled by one of said local battery subscribers for connecting said interrupter in circuit with said signal to open and close the circuit of said signal, thereby intermittently operating the same.

13. A telephone system including common battery and local battery telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, means controlled by one of said common battery subscribers for causing a continuous glow of said signal, an interrupter, a relay controlled by one of said local battery subscribers for connecting said interrupter in circuit with said signal to open and close the circuit of said signal to cause the same to flash, and operator-controlled means for disassociating said interrupter from said signal.

14. A telephone system including local battery and common battery subscribers' telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, a relay for said cord circuit, an interrupter, means controlled over one of said common battery lines for causing the de-energization of said relay to effect a continuous glow of said signal, and means controlled over a local battery line for causing an energization of said relay to connect said interrupter in circuit with said signal to cause an intermittent operation of the same.

15. A telephone system including local battery and common battery subscribers' telephone lines, a universal cord circuit for interconnecting said lines, a signal for said cord circuit, a relay for said cord circuit, an interrupter, means controlled over one of said common battery lines for causing the de-energization of said relay to effect a continuous glow of said signal, means controlled over a local battery line for causing an energization of said relay to connect said interrupter in circuit with said signal to cause an intermittent operation of the same, and operator-controlled means for disassociating said interrupter from said signal.

16. A telephone system including local battery and common battery telephone lines, a universal cord circuit for interconnecting said lines, a supervisory signal for said circuit, a supervisory relay, a switching relay,

means operable when said cord circuit is connected to a common battery one of said lines to operate both of said relays, subscriber-controlled means for de-energizing said supervisory relay, thereby causing a continuous operation of said supervisory signal, and means controlled over a local battery one of said lines for energizing said supervisory relay, thereby connecting said interrupter in circuit with said signal to cause an intermittent operation of the same.

17. A telephone system including local battery and common battery telephone lines, a link circuit for interconnecting said lines, a supervisory signal, a supervisory relay, and a switching relay for said link circuit, said relays being operable when the link circuit is connected to one of said common battery lines to cause a continuous glow of said signal when disconnection is signaled for, and operable when connected to one of said local battery lines to connect an interrupter in the circuit of said signal when disconnection is signaled for to cause an intermittent operation of said signal.

18. A telephone system including magneto and common battery telephone lines terminating at a central office, a link circuit for interconnecting said lines, a signal for said link circuit, a pair of relays for said link circuit, means for energizing said relays and then de-energizing one of said relays when a common battery line is connected with, to cause a continuous operation of said signal to denote disconnection, and means for energizing one of said relays while permitting the other relay to remain at normal when a local battery line is connected with, to connect an interrupter in circuit with said signal to cause an intermittent operation thereof when disconnection is signaled for.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 31st day of July, 1918.

CHARLES SPARKS.