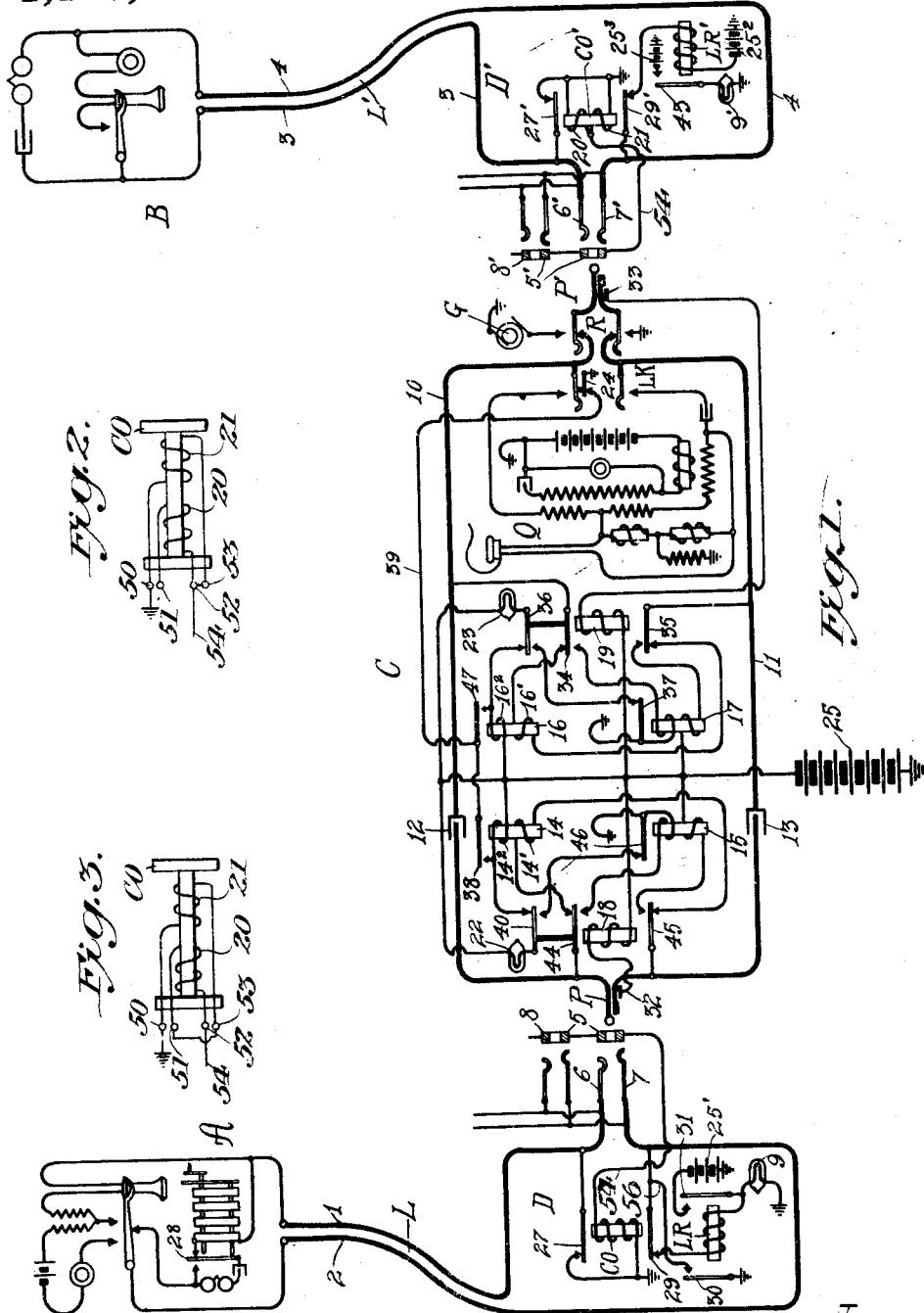


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TELEPHONE SYSTEM.

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1,107,371.



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TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHARLES A. SIMPSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in which service between the different types of lines is established and more particularly to systems in which connections may be established between so-called common battery and local battery substation telephone lines.

An object of my invention is to provide such a system having improved and simplified circuit arrangements which are positive in operation, other features thereof being more particularly pointed out in the following specification including the appended claims.

In telephone exchanges it has been found that the rates charged for different classes of service vary and that a higher rate for one class such as common battery service may be secured, than for another class of service such as the magneto lines, and therefore it is desirable in installing a magneto or local battery system that any of the telephone lines may be switched from the one to the other class of service. In switching from one class of service to another it is of great commercial importance that the least possible change be necessary and to this end I have provided a system in which no change of apparatus is necessary but only a few simple changes in the connection of the line circuit. In providing service to two classes of telephone lines it is also desirable to have link circuits which are universal in operation, and to this end I have provided a link circuit which is adapted for use in interconnecting the two classes of lines and automatically adjusting itself to such two classes of service.

Referring to the accompanying drawing, Figure 1 illustrates diagrammatically a circuit arrangement embodying my invention, Fig. 2 illustrates one method of connecting the windings of the cut-off relay CO when used for common battery service; and Fig. 3 illustrates one method of connecting the windings of the cut-off relay CO when used for magneto line service.

The system shown thereon includes a local-battery substation A connected to line conductors 1 and 2 terminating at exchange apparatus D, and a common-battery substation B connected to line conductors 3 and 4 which terminate in exchange apparatus D'. A cord circuit C is provided which is adapted for universal connection between such local and common-battery telephone lines preferably such as lines A and B of which there would be a plurality.

Substation A is a well known form of local battery substation telephone including the usual switchhook receiver, induction coil, transmitter and local battery which are normally out of circuit and a call-bell and condenser normally connected in bridge of the line conductors 1 and 2 through the normal switchhook contact. A hand generator is also provided for substation A for signaling the operator at the central office.

The exchange apparatus D of line L and substation A, comprises multiple jacks having their tip and sleeve contacts 6 and 7 respectively connected to the talking conductors of line L and a third contact, ring 8, connected to a cut-off relay CO. A line relay LR is also provided which is adapted to be operated by the calling subscriber to energize the line signal 9. The line L' of substation B terminates in exchange apparatus D' which includes apparatus similar to the exchange apparatus D, but differently connected as illustrated in the drawing.

Cord circuit C comprises answering and calling plugs P and P' respectively having their tip and sleeve contacts connected by conductors 10 and 11 respectively which have the condensers 12 and 13 interposed. A ringing key R is also provided being adapted when operated to connect current from generator G to the terminals of the called line. A listening key LK is provided, being adapted to connect the operator's telephone O with the talking conductors of the cord circuit. A pair of supervisory relays 14 and 15 are provided for the answering end of the cord circuit C and a similar pair 16 and 17 are provided for the calling end of the cord circuit. Switching relays 18 and 19 are connected to the third contact of plugs P and P' respectively

and are adapted to control the cutting in and out of their associated pair of supervisory relays.

Relays 18 and 19 are adapted not to be energized when their connected plugs are inserted in the jacks of local-battery lines such as L, but when their associated plugs are inserted into the jack of a common-battery line such as L', relays 18 and 19 are adapted to be energized. In accordance therewith I make the relays 18, 19 of comparatively low resistance, while the cut-off relays CO of the local battery lines L are of comparatively high resistance, so that when a relay 18 or 19 is connected through its plug to the jack and cut-off relay of a local-battery line, sufficient current will flow through the windings of the two connected relays in series to energize the cut-off relay CO, but not sufficient current to energize the relay 18 or 19 as the case may be, and in practice I find that making the relays 18, 19 100 ohms resistance and the cut-off relays CO of the local-battery lines L of 1000 ohms resistance, such operation of these relays will be secured.

Now as to the cut-off relays CO' of the common battery lines L', when connection is made with such lines as previously stated the relays 18 or 19 as the case may be, must energize and the cut-off relays CO' also energize. Therefore, the cut-off relays CO' of the common battery lines L' are wound to allow sufficient current to flow through their winding and a relay 18 or 19, so that both the connected relays will energize, and in practice I have found a resistance of 250 ohms for the relays CO' to give a satisfactory operation.

In order that the central office apparatus D and D' may be adapted for use in connection with local battery lines such as L and common battery lines such as L', I have arranged the cut-off relay CO' with two windings 20 and 21 of 500 ohms each, thus when connected as shown at CO' their total resistance is 250 ohms, and when using the cut-off relay for a local battery line as L, the two windings are connected in series as shown at CO, thus giving a total resistance of 1000 ohms. With this arrangement it will be seen that the efficiency of relays CO and CO' is maintained and it is only necessary to change the wiring of the apparatus at D or D' in order to accommodate such apparatus for common or local-battery service. Any suitable means of connecting the windings of the cut-off relay whereby it may serve as outlined above but in the accompanying diagrams Figs. 2 and 3, I have illustrated one method of connecting the terminals of the cut-off relay whereby it may be readily changed for serving either class of service. In using the cut-off relay for common battery service its windings are to be of

low resistance as outlined above and therefore they may be connected in multiple as shown in Fig. 2. That is, terminals 50 and 51 are connected together and to ground while terminals 52 and 53 are connected together and then to conductor 54. With this arrangement the windings 20, 21 are connected in multiple and offer the low resistance path for operating the switching relays 18, 19 of the cord circuit.

In Fig. 3 I have illustrated one method of connecting the windings 20, 21 in series so that a comparatively high resistance is offered to prevent the operation of switching relays 18, 19 when connected in series therewith. Assuming a magneto line as D had been installed with the cut-off relay connected as in Fig. 3, to change the line circuit to common battery as indicated at D', it is only necessary to change the windings of the cut-off relay from series to multiple by cutting the connection between terminals 51, 53 and connecting terminals 50, 51 together and terminals 52, 53 together. The winding of line relay LR is then disconnected from its armature contact 31 and connected direct to the battery as shown at D', and also the conductor 56 disconnected.

Referring again to the cord circuit C, it will be noted that supervisory relays 14 and 16 have their windings 14' and 16' normally in bridge of the answering and calling ends respectively of cord circuit C and as the relays 18 or 19 do not energize when connection is established with a local battery line such as L, these relays 14 or 16 are adapted to be operated by current from the hand generators at the connected substation to control the supervisory lamps 22 and 23. Locking windings 14² and 16² are provided for relays 14 and 16 to maintain these relays in an energized condition after their armatures are attracted, the locking circuit being controlled from the grounded contact 24 of key LK.

When connection is established with common battery lines such as L' by either plug P or P', relays 18 or 19 are energized as previously described thus disconnecting supervisory relay 14 or 16 and connecting supervisory relay 15 or 17 in bridge of the talking strands of the cord circuit. These relays 15 and 17 when connected in bridge of the talking strands of the cord circuit, as just described, are adapted to be controlled by current from battery 25 over the line conductors of a connected substation, and when thus connected are adapted to control supervisory lamps 22, 23.

Referring now to the operator's telephone O, this is so arranged that either common or local battery lines such as L or L' may be tested to determine their idle or busy condition. When lines L or L' are at normal without any plug connection, the rings 8 or

8' are connected through the cut-off relay to ground and when connection is established with the jacks 5 of these lines the potential of their jack rings 8 is raised due to the connection from battery 25 through a relay 18 or 19 and the third conductor of the plug. Thus when the operator tests the line to determine its condition, after throwing listening key LK, she reaches the tip of plug P to the ring 8 of the jack and if the connected line is busy she will receive a click in her receiver in the usual manner, indicating the busy condition of the tested line and if the line is idle she will receive no click and therefore is aware that the tested line is idle.

Operation Having described in general the system as illustrated, its operation will now be described. Assuming the subscriber at A, whose line is a so-called toll battery line, desires to communicate with another subscriber, he will operate his hand generator in the usual manner causing a flow of current through line relay LR from a ground in normal contact 27, line conductor 16, the hand generator of substation A, alternate contact 28 which is closed by the operation of the generator in a well known manner, switchhook contact, conductor 2, normal contact 29, winding of relay LR, and lamp 2 to ground, energizing relay LR which by the closing of its alternate contacts 30 and 31 establishes a locking circuit for itself by current from battery 25. The closing of contact 30 short circuits relay LR to prevent current from the hand generator to relay 1, further after once energized and the closing of contact 31 also causes the illumination of line signal 9 attracting the operator's attention who therefore inserts plug P in the answering jack 5 of the calling line. The connection of tip and sleeve contacts of plug P with the tip and sleeve contacts 6 and 7 of jack 5 establishes a talking connection between cord circuit C and the calling line, while the third contact 32 of plug P connecting with ring 8 connects cut off relay CO and relay 18 in series, both of the relays receiving a flow of current from battery 25 through the windings of the two relays in series to ground. Relay CO is energized, releasing its normal contact 27, and allowing signal 23, line relay LR, to become operative. The opening of contact 31 causes the circuit to break with the generator of A, means of key LK and the subscriber at A desires connection with the subscriber at B, whose substation is connected with a common battery line LR, the operator after restoring listening key LR, inserts plug P in a jack of line 17, thus establishing connection with the subscribers B, by means of the tip and sleeve contacts of the plug 2 of line 17. Due to the connection between a third contact 32 and ring 8, relays CO and 18 are connected in series and due to the lower resistance path

for current through the windings of relay CO, as connected when used with common battery lines relays 18 and CO are both energized by current from battery 25 through the windings of the two said relays in series to ground. The energization of relay CO causes the opening of its normal contacts 27 and 29, thus removing the substation control of line relay LR. Due to the energization of relay 18, relay 18 is disconnected from the calling end of cord circuit C and the closing of alternate contacts 31, 35 of relay 18, the battery 25 and windings of supervisory relay 17 are connected in series on the calling conductors leading to substation B, but there being no path for direct current through substation B, relay 17 does not energize. The operator now actuates listening key R, connecting generator G to the called line 17 and ringing the call-bell of substation B.

Returning now to relay 18 upon its energization as previously described, its alternate contact 29 is closed, thus establishing an energizing circuit for signal 23, current from ground through normal contact 31 of relay 17, alternate contact 36, lamp 23 to battery 25. Upon response of the subscriber at station B who removes his receiver from its switchhook, a path for direct current is established at the said substation, causing the energization of relay 17 which opens its contact 37 extinguishing supervisory lamp 23, indicating to the operator that the called subscriber has responded. This energizing current for relay 17 flows over a path from battery 25, the lower winding of relay 17, alternate contact 34, sleeve contacts of the plug and jack, conductor 4, substation B, returning over conductor 3, the contacts of jack and plug, conductor 10, alternate contact 34 and the upper winding of relay 17 to ground. The substations A and B are now connected for conversation, current for the transmitter of substation A being supplied from the local battery thereof, while talking current for substation B is supplied from battery 25 through the windings of relay 17.

After the subscribers have finished conversation they restore their receivers to their respective switchhooks. The restoration of the receiver at substation B interrupts the flow of current through relay 17 which de-energizes closing its normal contact 37 again causing the illumination of supervisory signal 23. After restoration of the receiver at substation A, the subscriber thereafter gives a ring-off operation to his hand generator, thereby causing a flow of current through the lower winding 14' of supervisory relay 14 which it will be noted is connected in bridge of the talking strands of the calling line and cord circuit C, said relay 14 becoming energized and closing its contact 38, 130

Due to the closing of said contact 38 a maintaining circuit for relay 14 is established by current from battery 25 through winding 14², alternate contact 38, conductor 39, to ground at normal contact 24. The closing of contact 38 also causes illumination of supervisory signal 22 by current from battery 25 through lamp 22, normal contact 40 to the grounded contact 38. The operator noting the illumination of the two supervisory lamps 22-23 withdraws plugs P and P', thereby restoring the relay 19 causing effacement of signal 23 and thereafter operates key LK to interrupt the circuit for relay 14 allowing said relay to restore, the interruption of the contact 24 also extinguishing the lamp 22. Also upon withdrawal of plugs P and P' cut-off relays CO and CO' are deenergized, restoring the substation control of line relays LR and LR'.

Assuming now that a connection is to be established between a calling common-battery line and a called local-battery line and that the call is initiated at substation B, the subscriber thereat by removing his receiver from its switchhook establishes a circuit for line relay LR' over a path traced from battery 25², winding of relay LR', normal contact 29', conductor 4, substation B, returning over conductor 3 and normal contact 27' to ground. Responsive to the energization of relay LR' its alternate contact 43 is closed, thereby establishing a circuit for lamp 9' which is lighted by current from battery 25³. The operator thereupon inserts answering plug P into the answering jack 5' of line L' thereby connecting the talking strands of the cord circuit C and line L' and also connecting the windings of relays 18 and CO' in series. Due to the low resistance path for current through relay CO' as previously described, said relay and relay 18 are energized by current from battery 25, the energization of relay CO' disconnecting relay LR' which restores, causing the effacement of line signal 9'. The energization of relay 18 disconnects the relay 14 and connects the windings of relay 15 in bridge of the talking conductors of the answering end of the cord circuit C. As at this time, substation B has its receiver removed from its switchhook, there will be a path for current over the calling line through the windings of relay 15, causing it to energize and interrupt its contact 46 preventing the lighting of lamp 22. The operator having ascertained the wants of the calling subscriber in the usual manner and finding that connection is desired with the line of substation A, she will insert calling plug P' in the jack 5 of the wanted line L, thereby connecting the talking conductors of the cord and line circuits as before. Also upon said connection relays CO and 19 are connected in series and due to the high re-

sistance of relay CO sufficient current does not flow through the coil of relay 19 to cause its energization, but relay CO is energized, removing the substation control of line relay LR. Due to the failure of relay 19 to energize, the winding 16' of relay 16 remains connected in bridge of the calling end of cord circuit C, to be actuated by the called subscriber at substation A for disconnection. The operator now actuates the ringing key in the usual manner to operate the bell of the called substation. The called subscriber at A thereupon removes his receiver from its switchhook without any effect upon any of the central office apparatus at this time. The calling substation B and called substation A are now connected for conversation, talking current for substation B being supplied from battery 25 through the windings of relay 15 and talking current for called substation A being supplied from the local battery thereat.

After the subscribers have finished conversation, the subscriber at B by replacing his receiver upon its switchhook interrupts the circuit for supervisory relay 15, allowing it to restore, thereby closing its contact 46 and causing the illumination of supervisory lamp 22. The called subscriber at A after replacing his receiver, operates his hand generator effecting the operation of relay 16 in a manner similar to the operation of relay 14 as previously described, relay 16 thereby closing its alternate contact 47 establishing a maintaining circuit for itself and causing the illumination of lamp 23, by current from battery 25 through the said lamp and normal contact 36, alternate contact 47 to ground at normal contact 24. The operator noting the illumination of the two supervisory signals 22 and 23 withdraws plugs P and P' from their connected jacks and thereafter actuates key LK, causing the restoration of relay 16 and the effacement of signal 23.

The withdrawal of plug P from jack 5' causes the restoration of relays 18 and CO', the restoration of the cut-off relay again placing the line relay LR' under control of substation B, while the restoration of relay 18 interrupts the circuit for lamp 22 at alternate contact 40, effacing the said lamp.

As previously stated, the cord circuit C is adapted for universal connection between the lines of different character such as L and L', so that it is also capable, beside making connections as described, of being used for establishing connection between two local battery lines such as L in which case neither relay 18 or 19 is energized and both of the supervisory relays 14 and 16 remain in bridge of their associated ends of cord circuit C. If connection is established between the two common battery lines such as L', both of the relays 18 and 19 are ener-

gized, thus disconnecting supervisory relays 14, 16 and in place thereof connecting relays 15, 17 in bridge of their associated ends of the cord circuit C, whereby they are placed under control of the subscribers at the connected stations as previously described.

Although several batteries are shown in the drawing, those shown at the central office may be one and the same, and while I have given certain resistance values for different relays, other values may be used, and furthermore, it is apparent that many changes and modifications of my invention may be made and I 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 Letters Patent of the United States is:

1. A universal cord circuit comprising a pair of talking conductors, terminating in answering and calling plugs, a pair of supervisory relays for each end of the cord circuit, and a switching relay for each end of the cord circuit for connecting either one of its associated supervisory relays in bridge of the talking strands.

2. A universal cord circuit comprising a pair of talking conductors, terminating in answering and calling plugs, a pair of supervisory relays for each end of the cord circuit, and a switching relay for each end of the cord circuit and connected to a third conductor of the associated plug, for connecting either one of its associated supervisory relays in bridge of the talking strands.

3. A universal cord circuit comprising a pair of talking conductors terminating in answering and calling plugs, a switching relay for each end of the cord circuit connected to a third contact of its associated plug, a supervisory relay for each end of the cord circuit having a winding connected in bridge of the talking conductors through normal contacts of the associated switching relay, and a second supervisory relay for each end of the cord circuit having a winding connected in bridge of the talking conductors through alternate contacts of the associated switching relay.

4. A universal cord circuit comprising a pair of talking conductors, terminating in answering and calling plugs, a pair of supervisory relays for each end of the cord circuit, a switching relay for each end of the cord circuit, and connected to a third conductor of the associated plug, for connecting either one of its associated supervisory relays in bridge of the talking strands, and a supervisory signal for each end of the cord circuit controllable by either one of its associated pair of relays.

5. A telephone system comprising common and local-battery telephone lines, a cord circuit for connection therewith, a pair of su-

pervisory relays for the answering end of said cord circuit, a switching relay for said cord circuit for connecting either one of said relays in bridge of the talking strands of the cord circuit, and means whereby said switching relay is or is not operated according to the character of the calling line when connection is made therewith, to operatively associate one of the supervisory relays with the talking strands of the cord circuit.

6. A telephone system comprising common and local-battery lines, a link circuit having a pair of talking conductors terminating in an answering plug, a pair of supervisory relays for the answering end of said link circuit, a switching relay connected to a third conductor of the plug for connecting either one of said relays in bridge of the talking strands of the link circuit, means whereby said switching relay is or is not operated according to the character of the calling line when connection is made therewith, to operatively associate one of the supervisory relays with the talking strands of the link circuit, and a signal controllable by either one of the pair of relays when operatively associated with the link circuit.

7. A telephone system comprising common and local battery telephone lines having their talking conductors terminating in jacks at the central office, cut-off relays for said lines, of different character according to the associated line, a link circuit for universal connection with said lines, a pair of supervisory relays for said link circuit, a switching relay for said link circuit for connecting one of said relays in bridge of the talking strands of the cord circuit, said switching relay being adapted to be connected in series with a cut-off relay when connection is made with a calling line, and means whereby said switching relay is or is not operated according to the character of the cut-off relay of the calling line when connection is made therewith, to operatively associate one of the supervisory relays with the talking strands of the cord circuit.

8. A telephone system comprising telephone lines of different characters, a universal cord circuit for interconnecting said lines, a pair of supervisory relays for each end of the cord circuit, and means for connecting either one of a pair of supervisory relays in bridge of the associated end of the cord circuit according to the character of the line connected with, and a supervisory signal for each pair of relays controlled by the connected relay of the pair.

9. A telephone system comprising common battery and local battery or magneto lines, and a universal cord circuit for interconnecting said lines, said cord circuit comprising three relays associated with each end, a supervisory signal for each end of the cord circuit, and circuit connections whereby said

signals are controlled by one of said relays when connection is made with a local battery or magneto line and by two of said relays when connection is made with a common battery line.

10. A telephone system comprising common battery and local battery or magneto lines, and a universal cord circuit for interconnecting said lines, said cord circuit comprising a pair of supervisory relays and a switching relay associated with each end, a supervisory signal for each end of the cord circuit, and circuit connections whereby a signal is controlled by one of said supervisory relays if connection is made with a local battery or magneto line and by the other of said supervisory relays and said switching relay if connection is made with a common battery line.

11. A telephone system comprising common battery and local battery or magneto lines, and a universal cord circuit for interconnecting said lines, said cord circuit having a normally operative supervisory relay corresponding to each end of said cord circuit and adapted to be operated when connection is made with a local battery or magneto line, and a normally inoperative supervisory relay corresponding to each end of the cord circuit, and means for rendering the normally operative relay inoperative and the normally inoperative relay operative to control the supervisory signal when connection is made with a common battery line.

12. A universal cord circuit comprising a pair of talking conductors terminating in answering and calling plugs, a supervisory electromagnet normally in bridge of said talking conductors at each end of the cord circuit, a switching relay corresponding to each end of the cord circuit and having normally closed contacts included in the circuit of the corresponding electromagnet, a pair of separate electromagnetic windings, for each end of the cord circuit and including chronic windings, and the corresponding magnetic cores whereby they may be connected in bridge of the talking strand of the cord circuit, and a supervisory signal and circuit connections for each end of the cord circuit adapted to be controlled by the common electromagnet or the electro-magnetic windings.

13. A telephone system including line circuit, having line and cut-off relays, connecting jacks associated with said circuits, magneto and common battery telephones associated with said line circuits respectively, the resistance of said line circuits being adjustable, and a universal cord circuit for interconnecting said lines including a pair of supervisory relays for each end thereof, each one adapted for serving one type of line, and a switching relay corre-

sponding to each pair of supervisory relays and adapted to be controlled according to the circuit connections of the line connected with whereby the corresponding supervisory relay is connected in operative relation with the line.

14. A telephone system comprising magneto and common battery lines, line circuits for said lines comprising line and cut-off relays, the circuit connection of the cut-off relays being adapted to be varied according to the associated line, and a universal cord circuit for interconnecting said lines having two supervisory relays for each end, one being adapted for use with a magneto line and the other for use with a common battery line, and a third relay for each end of the cord circuit adapted to be connected in circuit with the cut-off relay when connection is made with a line and differently operative according to the connections of the connected cut-off relay for rendering the proper supervisory relay effective.

15. A telephone system comprising line circuits having line and cut-off relays, the cut-off relays being adapted to be differently connected in circuit to adapt the line for magneto or common battery service, and a cord circuit for extending the circuit of said lines having two supervisory relays one adapted for use for each character of service, and a switching relay differently operative according to the cut-off relay connections of the line connected with whereby only the proper supervisory relay is rendered effective.

16. A telephone system comprising line circuits having line and cut-off relays, jacks for said lines, a circuit connection including a jack and cut-off relay of each line circuit, a cord circuit for extending the circuit of said lines including a switching relay, means for varying the resistance of the said cut-off relay circuits to adapt said line circuits for magneto or common battery service, connections whereby a cut-off relay and switching relay are connected in circuit upon connection with a line jack by said cord circuit, said switching relay being operable only upon such connection with one type of line circuit but said cut-off relay being operable irrespective of the resistance of the said circuit in which it is connected.

17. A telephone system comprising line circuit having cut-off relays, jacks for said lines, a circuit including a jack and cut-off relay winding for each line circuit, a cord circuit for extending the circuit of said line including a switching relay, means for varying the connections of said cut-off relay winding so as to vary the resistance of the said circuit in which it is included, connections whereby a cut-off relay and switching relay are connected in circuit upon connection with a line jack by said cord circuit,

said switching relay being operable only upon connection with one type of line circuit but said cut-off relay being operable irrespective of the resistance of its winding.

- 5 18. A telephone system comprising line circuits having cut-off relays, jacks for said lines, a circuit including a jack and cut-off relay for each line circuit, a cord circuit for extending the circuit of said lines including
10 a switching relay, means for varying the resistance of said cut-off relay circuits to adapt said line circuits for magneto or common battery service, connections whereby a cut-off relay and switching relay are connected
15 in circuit upon connection with a line jack by said cord circuit, said switching relay being operable only upon such connection with one type of line circuit but said cut-off relay being operable irrespective of the resistance of the said circuit in which it is connected.
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19. A telephone system comprising common battery and local battery or magneto lines, a universal cord circuit for intercon-

necting said lines, said cord circuit having a normally operative supervisory control winding corresponding to each end of said cord circuit and adapted to be operated by substation generator current when connection is made with a local battery or magneto line, normally inoperative supervisory control windings corresponding to each end of the cord circuit, means for rendering the normally operative winding inoperative and the normally inoperative windings operative when connection is made with a common battery line, and a common source of transformer supply current adapted to be fed through the last said windings.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

CHARLES A. SIMPSON.

Witnesses:

GEORGE E. MURPHY.
CARIE E. ANDERSON.