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TELEPHONE EXCHANGE SYSTEM.

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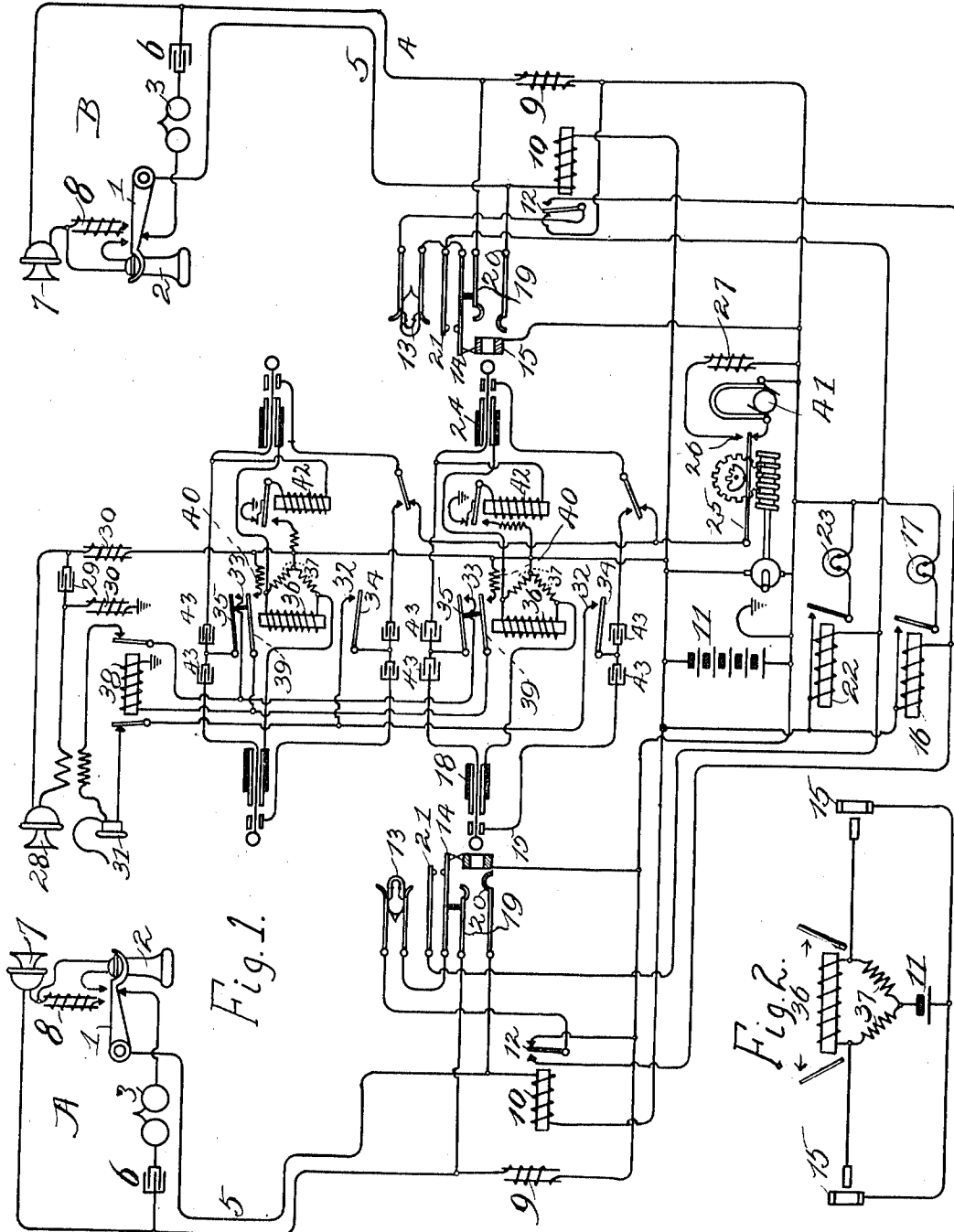


Fig. 1.

Fig. 2.

Witnesses:

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TELEPHONE-EXCHANGE SYSTEM.

1,061,516.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CHARLES A. BALS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems, and has for its objects, first, the provision of improved means for governing the association of the operator's telephonic outfit with the link connectors that are employed to unite subscribers' lines in conversation, and, second, the provision of means whereby an operator is prevented from listening to the conversation of both parties to an established connection.

My invention will be fully explained by reference to the accompanying drawing, showing the preferred embodiment thereof, in which—

Figure 1 indicates two telephone lines extending between sub-stations or subscribers' stations and an exchange, at which exchange apparatus is provided for uniting and disconnecting telephone lines. Fig. 2 is a simplified diagram of certain of the apparatus illustrated in Fig. 1.

Like parts are indicated by similar characters of reference in both figures.

In the illustration of my invention, a variety of features are illustrated which are not of my invention, my invention relating to the means for controlling the association of the operator's telephone receiver with telephone lines for the purposes of automatically cutting said telephone into and out of circuit and for preventing the operator from listening to the conversation of more than one of two communicating subscribers.

In the embodiment of the invention illustrated, there are two subscribers' stations, A, B, each having a telephone switch-hook 1 adapted, when holding the receiver 2, to include a call bell 3 in bridge of the limbs 4, 5 of each line, in which bridge is included a condenser 6. Other types of sub-station outfit may, however, be employed. When the switch-hook at each station is relieved of the telephone receiver thereat, the receiver, in rising, opens the bell bridge and includes

the telephone receiver 7 in series with the limbs 4, 5 of the associate telephone line and in series with the receiver 2, an impedance coil 8 being then included in shunt of the telephone receiver. The limb 4 of each telephone line includes an impedance winding 9 and the limb 5 of each telephone line includes an electro-magnet or relay winding 10. The limbs of the telephone lines are united by a common battery 11, whereby when a receiver is removed from its switch-hook at a calling sub-station, the relay 10 is energized to operate an armature 12, which serves to include a signal device, preferably a lamp 13, in a circuit which may be traced from the upper terminal of the battery 11 to the alternate contact of the armature 12 (by way of mechanism which will be mentioned later), the signal lamp 13 corresponding to the station from which the telephone receiver has been removed, assuming such station to be a calling station, a jack spring 14, a thimble 15 with which the jack switch 14 is separably engaged, to the lower terminal of the battery 11. The lamp 13, when thus included in circuit, conveys a steady signal to the operator, who is thereby informed that the subscriber whose line corresponds to the lamp 13 desires to initiate a call. In order that the operator may have a check upon the line signals of calling subscribers, the circuit established through the signal device 13 for calling purposes may also include a line pilot relay 16 common to a plurality of calling or line signal circuits that include the devices 13. The line pilot relay 16 has an armature, which, when circuit is closed through such pilot relay, establishes circuit through the pilot signal device 17, which is preferably a small incandescent lamp, the circuit of the line pilot signal device 17 being traceable from the upper pole of the battery 11, the armature of the line pilot relay 16, and the contact engaged by said armature when said armature is attracted, the line pilot signal device 17, to the lower pole of the battery 11. The operator, in responding to the line signal, inserts the answering plug 18 into the jack of the calling subscriber, the tip of the answering plug engaging the tip line spring 19 of such jack, the sleeve of the answering plug engaging the spring 20 of such jack (the springs 19 and 20 constituting talking contact terminals of the calling

line), while the heel or body of the answering plug engages the thimble 15. The spring contacts 14 and 19 are mechanically connected, so that when the tip of the answering plug 18 engages and holds up the tip line spring 19, the contact spring 14 is elevated and maintained elevated during the presence of the answering plug in said jack, to disconnect the contact 14 from the thimble 15 and bring and maintain said contact 14 in engagement with an alternate contact 21, with results that are now to be described. As the lamp 13 and the line pilot relay 16 are in serial relation, the circuit for the line pilot relay 16 is open at the parts 14 and 19, so that when the line signal occasioned by the signal device 13 is effaced, the circuit through the line pilot relay 16 is opened, in so far as such circuit is dependent upon continuity of the circuit through the line signal device 13, though, of course, it is apparent that the line pilot relay 16 may continue to have its circuit closed through some other line signal device 13.

The jack associated with the line B as well as the jacks associated with other lines of the system, have parts similar to the parts just described in connection with the jack of the line belonging to subscriber A and also has similar association with a signal device 13, the similar parts being given similar characters of reference. If the line B should happen to be the calling line, then the answering plug 18 would bring about the same results which it has been described as performing in connection with the line of subscriber A.

Before proceeding with the description as to the manner to which connection is established between the subscribers, it may at this point be well to anticipate the function which the signal device 13 is adapted to perform as a clearing-out signal in association with the calling telephone line (the line of subscriber A, for example). When the operator has inserted the answering plug, although she has excluded the signal device 13 from circuit by separating the contact 14 from the thimble 15, yet, she has partially established an alternate circuit for the signal device by the engagement of the contact 14 with the contact 21, and inasmuch as the contact 21 is connected by means of a conductor with the upper terminal of the battery 11, and inasmuch as the normal contact of the associate armature 12 is connected with the lower terminal of the battery 11, the said alternate circuit for the signal device 13 is established when the subscriber at said station (A) opens the circuit if the windings 9, 10 by restoring his telephone upon its switch-hook, the opening in the circuits of the windings 9, 10 occurring at the sub-station, permitting the armature 12 to fall back to engage its normal contact,

whereby the circuit for the signal device 13 partially closed by the engagement of the elements 14, 21, is completely closed by the engagement of the released armature 12 in engaging its normal contact. Thus the signal 13 is adapted at one time to present a line signal and at another time to present a clearing-out signal. A second pilot relay 22 is provided in association with the signal devices 13, which second pilot relay is included in the conductor that unites contact 21 with the upper terminal of the battery 11. This second pilot relay 22, by being included in the conductor that unites the contact 21 with the upper terminal of the battery 11, constitutes a supervisory pilot relay, inasmuch as it depends for the continuity of its circuit upon the presence of answering plugs within the jacks, the presence of the plugs within the jacks determining the alternative circuits for the signal devices 13, which include the relay 22, in order that such signal devices 13 may then act as disconnect signals. The relay 22 is common to a plurality of signal devices 13 and may be in closed circuit if one or more of the disconnect circuits for the signal devices 13 are closed, all of such disconnect signal circuits being necessarily opened before the circuit of the supervisory or disconnect pilot relay 22 is opened. The disconnect pilot or supervisory relay 22 is adapted to include a supervisory or disconnect pilot signal device 23 in a circuit which may be traced from the lower terminal of the battery 11, through the pilot signal 23, the armature of the pilot relay 22, the contact of the pilot relay 22, to the upper terminal of the battery 11. The presentation of the disconnect signal and the signal due to the signal device 23, may occur after the operator has answered a calling subscriber and before the operator has inserted the connecting plug within a jack of a called subscriber, if the calling subscriber happens to change his mind before the operator has had opportunity to connect his line with a called subscriber's line. But assuming that the calling subscriber has not restored his receiver to his switch-hook so soon, and assuming that the calling subscriber has requested connection with a called line, as, for example, the line of the subscriber B, the operator selects the mate 24 to the answering plug 18, and inserts it within the jack of the called subscriber's line, whereby the same mechanical changes are effected among the parts of the spring jack engaged by the connecting plug, so that, though circuit may be established through the windings 9 and 10 of the called subscriber's line when the called subscriber removes his telephone from its switch-hook, yet, the called subscriber will not thereby occasion the operation of the signal device 13, as a circuit connection for said signal

device was previously broken at 14 and 21 by the connecting plug brought to rest with its tip in engagement with the line spring 19. When the called subscriber is through conversation, he restores his receiver to its switch-hook, and thereby permits the armature 12 (which was attracted during the time that the called subscriber had his receiver off of its switch-hook) to fall back, thereby to establish an alternate circuit (constituting a clearing-out circuit) for the associate signal device 13, similar to the clearing-out circuit established for the signal device 13 associated with the line of subscriber A, to indicate to the operator that the called subscriber is through with the connection and that the connecting plug may be pulled out of the engaging jack. I do not, therefore, deem it necessary to recite in detail the manner in which the signal device 13 illustrated at the right of the drawing acts to present a clearing-out signal due to the restoration of the receiver at the station B, as the circuit changes that are effected by the restoration of the receiver of the subscriber B to its switch-hook and the consequent falling back of the armature 12 are similar to the circuit changes concerning the signal device 13 that are effected when the receiver at the calling substation A is restored to its switch-hook. The signal device 13 in association with the line at the subscriber's station B has association with the pilot relays 16 and 22 similar to the association of the signal device 13 corresponding to the line A with said pilot relays. A third function is possessed by each signal device 13 when the line associated therewith happens to be a called line, which function is to inform the operator of the presence of the receiver of the called line upon its switch-hook prior to its removal by the called subscriber in response to a call. Inasmuch as the line and clearing-out signals are unintermittently displayed by the signal devices 13, the said third function of said signal devices is performed by causing the same to be intermittently included in circuit. The stated third function of each signal device 13 is performed by including it in a circuit which may be traced from the lower terminal of the battery 11 to the normal contact of the armature 12 of the called subscriber's line relay which is unattracted during the time that the called subscriber's receiver is upon its switch-hook, the signal device 13 associated with the called line, the contact spring 14, the contact spring 21 engaged therewith through the agency of the connecting plug, to the upper terminal of the battery 11, there being means for intermittently attracting the armature 12 during the time that the called subscriber's receiver is upon its hook prior to the response of the called subscriber, so as to interrupt the

circuit through the lamp 13 to enable said lamp to perform the stated third function. This means, in the embodiment of the invention illustrated, resides in an intermittently operated switching device including an intermittently actuated contact 25 and a contact 26 intermittently engaged by the contact 25, the contacts 25, 26 being included in a circuit which may be traced from the lower pole of the battery 11 through the impedance winding 27, the contacts 25, 26, the sleeve of the connecting plug, the sleeve jack spring 20, the winding 10, to the upper terminal of the battery 11. The winding 10 is thus intermittently included in circuit to intermittently attract the armature 12, thereby intermittently to energize the lamp 13, so that said lamp may perform the said third function, namely, to inform the operator during the time that the called subscriber permits his telephone to remain upon its switch-hook before responding to his call.

I will now refer to the control of the operator's telephone equipment, which equipment is brought into service automatically, in accordance with the preferred embodiment of my invention, when the operator inserts an answering plug within the jack of a calling line. The operator's telephone equipment includes, in the embodiment of the invention illustrated, a transmitter 28 in a local circuit including the battery 11, as will be apparent by an inspection of the diagram, there being a second local circuit for this transmitter which includes a part of the conductor of the first circuit and in addition a condenser 29 which enables this second circuit to be closed with respect to telephonic currents, but to be open with respect to direct current to the battery 11, there being impedance coils 30 in portions of the first circuit that are not common to the second circuit for preventing the voice currents from passing away from said second circuit to which they should be preferably confined. The said second local circuit for the transmitter 28 is inductively related with the circuit for the operator's receiver 31, said receiver being included in a conductor having multiple terminals 32 upon one side of the receiver and multiple terminals 33 upon the other side of the receiver, these terminals being normally out of contact with armature switches 34, 35 that are governed by an electro-magnet or relay 36, there being one relay 36, together with its associate armature switches 34, 35, per cord or link circuit. The winding of each relay 36 is in series relation with the heels or body portions of the answering and connecting plugs. Said winding is in parallel with a resistance 37 connected at its mid portion with one terminal of the battery 11, said terminal of the battery 11 being connected through the halves of the resistance 37 with

the heels or body portions of the plugs. The remaining terminal of said battery is in common connection with the thimbles 15. Assuming, for sake of illustration, that the winding of a relay 36 is of four hundred ohms resistance and that each half of the resistance 37 possesses a resistance of four hundred ohms, it will be seen that when the answering plug is inserted within a jack of the calling line, that although there is a closed circuit thereupon established including but one-half of the resistance 37 and the battery 11, there is also established another circuit for the battery 11 that includes the remaining half of the resistance 37 and the winding of the associate relay 36, so that said relay 36 is sufficiently energized to attract its armature switches 34, 35, thereby to engage said armature switches respectively with the associate contacts 32, 33, thereby to include the operator's telephone receiver in bridge of the link circuit, inasmuch as the armature switches 34, 35 are respectively connected with the sleeve and tip strands of the link or cord circuit. The operator is thus enabled to listen to the wants of a calling subscriber. When the operator inserts the connecting plug within the jack of a called subscriber, another local circuit is established for the battery 11, which includes the remaining half of the resistance 37, the heel or body portion of the connecting plug, and the thimble of the jack corresponding to the called line. The current for the battery 11 thus has two local circuits, the winding of the relay 36 being deprived of current when both local circuits are closed, inasmuch as there is no difference in potential between the terminals thereof when said two local circuits including the halves of the resistance 37, are established. Having ascertained the connection desired, the operator inserts the connecting plug 24 within the jack of the called line, to deenergize the relay 36, as has been stated, and thereby to cut out the operator's telephone set from circuit relation with the link circuit that is to establish connection between the calling and called lines. If the operator should desire to listen to the conversation of either party to a connection, she may, by removing the connecting plug, listen to the calling subscriber, and, by removing the answering plug, listen to the called subscriber; but by means of my invention, she is not enabled to listen to both subscribers, even though she may manipulate other plugs, as I have provided means to guard against the looping in of the operator's telephone outfit. In practising this feature of my invention, the operator's receiver circuit includes the armature switches of a relay 38, insufficient current normally flowing through the circuit of the relay 38 to prevent it from moving its arma-

tures, and thereby cutting out the operator's receiver from circuit. The circuit through which this normally insufficient current flows may be traced from the grounded terminal of the relay 38 to the multiply related armature switches 39, a single one of which should be only attracted, the contact engaging the attracted armature switch 39, a resistance 40 provided for the purpose of sufficiently reducing the current to prevent the operation of relay 38 when but one armature switch 39 is attracted to the battery 11, and thereafter its grounded terminal. If the operator should endeavor by manipulation of a plug or plugs of companion cord circuits, to listen in to both parties to an established circuit, she will at least include one resistance 40 in parallel with the previously described resistance 40, thereby to sufficiently increase the current flowing through the relay 38 to energize said relay and open the circuit of the receiver 31. Thus the system of my invention is semisecret, in that the operator is enabled to listen to the speech of but one subscriber, and this being the case, the system of my invention is, in effect, one which prevents the operator from listening in, as an operator's interference with an established connection will be apparent to the subscriber who is in telephonic communication with the operator.

When a connecting plug is inserted within the jack of a called line, the condition is such that the circuit for the signaling current is established, which circuit may be traced from the upper terminal of the calling generator 41 to the switch arm 25, the normal contact of the lower armature switch of relay 42, the sleeve of the connecting plug, the line spring 20 of the jack, to the line limb 5 of the called line, where the calling current divides, a sufficient portion passing through the called subscriber's bell 3 by way of the limb 5, the switch-hook 1, the condenser 6, the limb 4, the coil 9 of the called subscriber's line, to the lower terminal of the calling generator 41, to operate the bell 3, the balance of the divided current from the calling generator 41 flowing through the winding 10 of the called subscriber's line relay, through the battery 11 to the same lower terminal of the generator 41. The calling generator 41 thus supplies sufficient current to operate the call bell 3 at the called station, and owing to the fact that the circuit for that portion of the calling current passing through the coil 10 of the called subscriber's line relay is intermittently interrupted between the switch arm 25 and the lower contact therefor, the armature 12 in addition to being intermittently released, due to separation of the contacts 25, 26, as has been specified, is further intermittently released due to the separation of the contact 25 and the one below it, where-

by circuit through the signal device 13 is not only intermittently interrupted during the absence of calling current upon the called line, but is also intermittently interrupted during the presence of the calling current upon the called line, so that the operator cannot mistake the character of the signal conveyed by the device 13. During the time that calling current is being impressed upon the called line, a portion of the current emanating from the generator 41 is caused to pass over the calling subscriber's line through the receiver at the calling subscriber's station to inform the calling subscriber that the called subscriber's signal bell is being operated, this small portion of the calling current flowing over the calling subscriber's line until the called subscriber removes his telephone from its switch-hook. To this end, a portion of the calling current flowing over the limb 4 of the called subscriber's line is diverted from the coil 9 of the called subscriber's line and is caused to pass through the line spring 19, the tip of the connecting plug 24, the tip of the answering plug 18, the tip spring 19 of the calling subscriber's jack, the limb 4 of the calling subscriber's line, the limb 5 of the calling subscriber's line, through the winding 10 of the calling subscriber's line relay (which circumstance does not affect said line relay inasmuch as it is already energized, owing to the closure of circuit there-through at the calling subscriber's station), the battery 11, to the lower pole of the generator 41, the upper pole of said generator to the limbs 4 and 5 of the called line, to the point of connection of the limb 4 with the tip line spring 19. There being condensers 43 in the talking strands of the cord circuit of proper capacity, the portion of the calling current passing over the calling subscriber's line is sufficiently reduced to prevent objectionable operation of the telephone receiver at the calling station. When the called subscriber responds by removing his telephone from its switch-hook, circuit is established for the relay 42, which may be traced from the lower pole of the battery 11, through the normal contact of the upper armature switch, through the winding of the relay 42, the tip of the connecting plug 24, the tip line spring 19, the limb 4 of the called line, the transmitter and telephone receiver at the called station, the limb 5 of the called line, the winding 10 of the line relay of the called line, back to the upper pole of the battery 11. The normal contact of the upper armature switch of the relay 42 (there being one such relay 42 per link circuit) is a follow-up contact, by which is meant that the upper armature switch, though moved upon the energization of the relay 42, is not separated from its normal contact until after it has

engaged its alternate contact, the armature switch continuing in its movement after its engagement with its alternate contact, effectively to part from the normal contact and firmly engage the alternate contact, by which operation a locking circuit is established for the relay 42 to maintain the armature switches of said relay in attracted positions so as to insure the separation of the calling generator from the called line after the called party has responded. The locking circuit may be traced from the lower pole of the battery 11, through the impedance 9, the spring 19, the top of plug 24, the winding of the relay 42, the upper armature switch of said relay, the alternate contact of said upper armature switch, to the upper terminal of the battery 11. It will be observed that the relay 42 is instantly included in circuit when the called subscriber responds whether calling current be passing over the called subscriber's line or not, so that in the event of the called subscriber removing his telephone receiver from its hook during the time that calling current is passing over the called line, such calling current is instantly removed from circuit relation with the called line, so that there is never any likelihood of the called subscriber having his receiver violently operated by the calling current.

The mechanism for intermittently operating the switch arm 25 is of such a nature that during a part of the time it has intermittent engagement with the upper contact only and during a part of the time with the lower contact only.

Cross reference is made to a co-pending application disclosing some of the features that are herein disclosed, as follows: Serial No. 453,541, filed September 17, 1908 and renewed August 14, 1911 under Serial No. 644,043.

While I have herein shown and particularly described the preferred embodiment of my invention, I do not wish to be limited to the precise construction and arrangement set forth, as changes may readily be made without departing from the spirit of the invention.

Having thus described my invention, I claim as new and desire to secure by Letters Patent the following:—

1. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits, each provided with terminal plugs adapted for connection with telephone lines to unite the same in conversation, an operator's telephone outfit adapted for telephonic connection with the telephone lines, switching mechanism governing the association of the operator's telephone outfit with the telephone lines, an electro-magnet governing the operation of said switching mechanism, a source of cur-

rent for energizing said electro-magnet, switching devices governed by the plugs of each cord circuit, and circuit connections governed by said plugs and switching devices, whereby when a plug and one of said switching devices co-act, current is caused to flow through said electro-magnet to cause it to operate the switching mechanism, and when both plugs coöperate with both switching devices, current is diverted from said electro-magnet to cause it to release the switching mechanism that it controls, thereby to remove the operator's telephone set from circuit relation with united telephone lines, said circuit connections defining local circuits to which said source of current is common, there being resistance in parallel with the electro-magnet winding with a mid portion of which said source of current is connected, whereby each of said local circuits includes a part of said resistance and whereby when both local circuits are established, the electro-magnet is deprived of current, owing to the lack of the necessary difference of potential between its terminals due to said resistance and the connection of the source of current therewith, each of said local circuits being exclusive of said electro-magnet, which, therefore, only receives current through the resistance portion of the open local circuit when the companion local circuit is closed.

2. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits, each provided with terminal plugs adapted for connection with telephone lines to unite the same in conversation, said telephone lines having jack switches for the reception of the plugs, an operator's telephone outfit adapted for telephonic connection with the telephone lines, switching mechanism governing the association of the operator's telephone outfit with the telephone lines, an electro-magnet, governing the operation of said switching mechanism, a source of current for energizing said electro-magnet, and circuit connections leading to said jack switches and said plugs, whereby when a plug and one of said jack switches co-act, current is caused to flow through said electro-magnet to cause it to operate the switching mechanism, and when both plugs coöperate with both jack switches, current is diverted from said electro-magnet to cause it to release the switching mechanism that it controls, thereby to remove the operator's telephone set from circuit relation with united telephone lines, said circuit connections defining local circuits to which said source of current is common, there being resistance in parallel with the electro-magnet winding with a mid portion of which said source of current is connected, whereby each of said local circuits includes a part of said resistance and where-

by when both local circuits are established, the electro-magnet is deprived of current, owing to the lack of the necessary difference of potential between its terminals due to said resistance and the connection of the source of current therewith, each of said local circuits being exclusive of said electro-magnet, which, therefore, only receives current through the resistance portion of the open local circuit when the companion local circuit is closed.

3. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit relation with the cord circuits, electro-magnetic mechanism adapted, when sufficiently energized, to prevent the operative association of the operator's telephone outfit with the cord circuits, a source of current, and resistances, one per cord circuit, adapted to be included in circuit with said electro-magnetic mechanism and said source of current and whose circuit relation with said electro-magnetic mechanism is governed by the cord circuit apparatus, the said resistances of the different cord circuits being in parallel relation, whereby a plurality of such resistances thus connected in parallel will permit the flow of sufficient current to effect the operation of the electro-magnetic mechanism to render the operator's telephone outfit temporarily inoperative, a single one of said resistances sufficiently reducing the flow of current to said electro-magnetic mechanism to prevent said electro-magnetic mechanism from operating.

4. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit relation with the cord circuits, electro-magnetic mechanism adapted, when sufficiently energized, to prevent the operative association of the operator's telephone outfit with the cord circuits, a source of current, and resistances, one per cord circuit, adapted to be included in circuit with said electro-magnetic mechanism and said source of current and whose circuit relation with said electro-magnetic mechanism is governed by the cord circuit apparatus, the said resistances of the different cord circuits being in parallel relation, whereby a plurality of such resistances thus connected in parallel will permit the flow of sufficient current to effect the operation of the electro-magnetic mechanism to render the operator's telephone outfit temporarily inoperative, a single one of said resistances sufficiently reducing the flow of current to said electro-magnetic mechanism to prevent said electro-magnetic mechanism from operating, the cord circuit apparatus

governing the association of said resistances with said electro-magnetic mechanism including an electro-magnetic device or relay per cord circuit, a switch governed by each
 5 relay and for connecting the aforesaid resistance of said cord circuit with the first aforesaid electro-magnetic mechanism, and switching mechanism governed by the cord circuit for governing the operation of said
 10 electro-magnetic device or relay.

5. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's telephone
 15 outfit adapted for circuit relation with the cord circuit, electro-magnetic mechanism adapted, when sufficiently energized, to prevent the operative association of the operator's telephone outfit with the cord circuits,
 20 a source of current, and means jointly made effective and controlled by a plurality of cord circuits for operating said electro-magnetic mechanism to render the operator's telephone set temporarily inoperative.

25 6. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit relation with the
 30 cord circuits, and means jointly made effective and controlled by a plurality of cord circuits for rendering said operator's telephone outfit temporarily inoperative.

7. A telephone exchange system including
 35 telephone lines extending from sub-stations to an exchange, operator-controlled link circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit relation with the operator-controlled
 40 link circuits, and means jointly made effective and controlled by a plurality of operator-controlled link circuits for rendering said operator's telephone outfit temporarily inoperative.

45 8. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit relation with the
 50 cord circuits, means jointly made effective by a cord circuit that is in use to establish a connection, and another cord circuit for rendering said operator's telephone outfit temporarily inoperative.

55 9. A telephone exchange system including telephone lines extending from sub-stations to an exchange, operator-controlled link circuits for uniting lines in conversation, an operator's telephone outfit adapted for circuit

relation with the operator-controlled
 60 link circuits, means jointly made effective by an operator-controlled link circuit that is in use to establish a connection, and another operator-controlled link circuit for rendering said operator's telephone outfit tempo-
 65 rarily inoperative.

10. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation; an operator's tele-
 70 phone outfit adapted for circuit relation with the cord circuits, and means jointly made effective and controlled by a plurality of cord circuits and line switches for rendering said operator's telephone outfit tempo-
 75 rarily inoperative.

11. A telephone exchange system including telephone lines extending from sub-stations to an exchange, operator-controlled link circuits for uniting lines in conversation, an operator's telephone outfit adapted
 80 for circuit relation with the operator-controlled link circuits, and means jointly made effective and controlled by a plurality of operator-controlled link circuits and line
 85 switches for rendering said operator's telephone outfit temporarily inoperative.

12. A telephone exchange system including telephone lines extending from sub-stations to an exchange, cord circuits for uniting lines in conversation, an operator's tele-
 90 phone outfit adapted for circuit relation with the cord circuits, means jointly made effective by a cord circuit that is in use to establish a connection, another cord circuit,
 95 and line switches for rendering said operator's telephone outfit temporarily inoperative.

13. A telephone exchange system including telephone lines extending from sub-stations to an exchange, operator-controlled link circuits for uniting lines in conversation, an operator's telephone outfit adapted
 100 for circuit relation with the operator-controlled link circuits, means jointly made effective by an operator-controlled link circuit that is in use to establish a connection, another operator-controlled link circuit, and line switches for rendering said operator's
 105 telephone outfit temporarily inoperative.

110 In witness whereof, I hereunto subscribe my name this eleventh day of February, A. D. 1909.

CHARLES A. BALS.

Witnesses:

G. L. CRAGG,
 L. G. STROH.