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TELEPHONE EXCHANGE SYSTEM.
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2 SHEETS—SHEET 1.

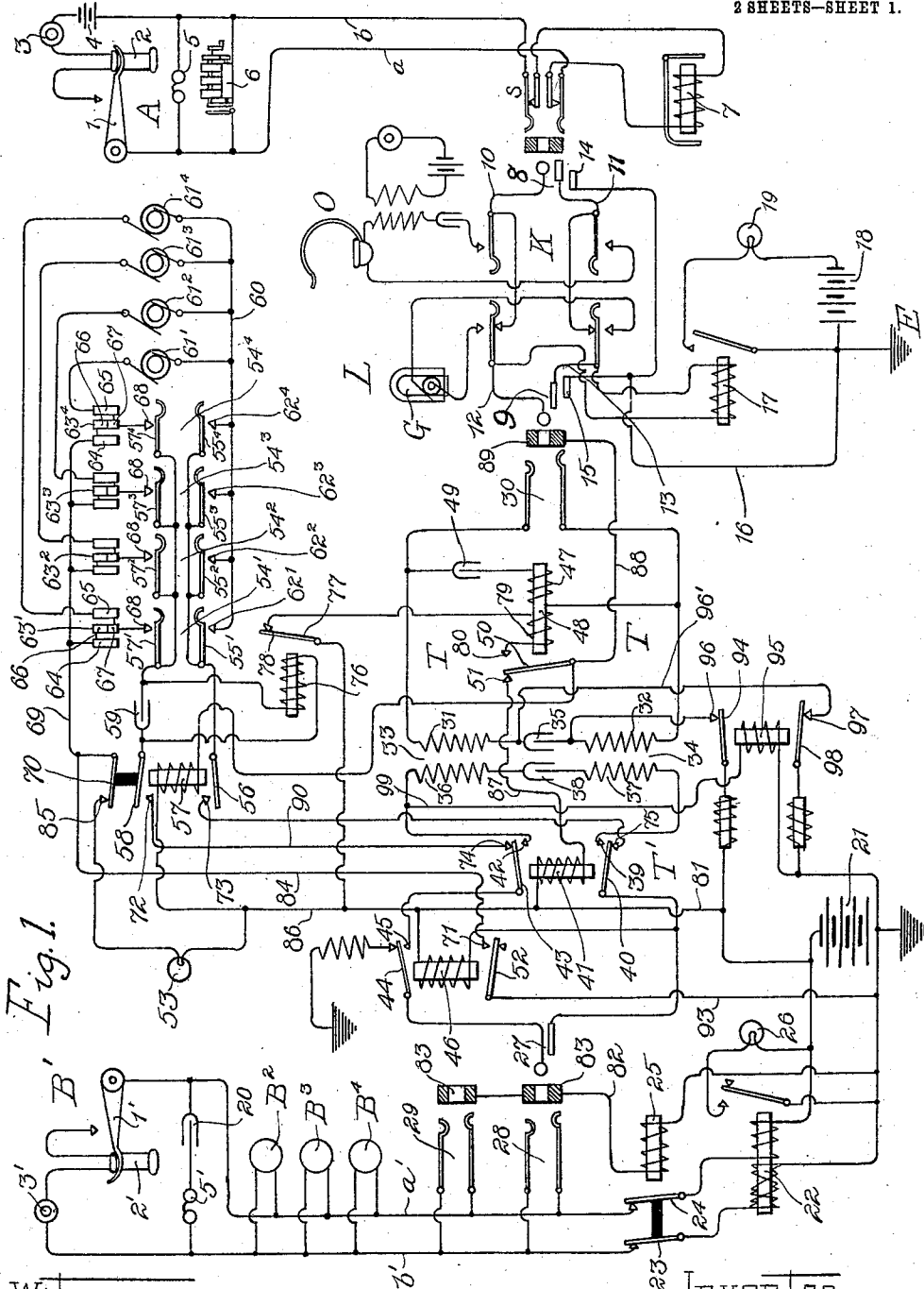


Fig. 1.

Witnesses:

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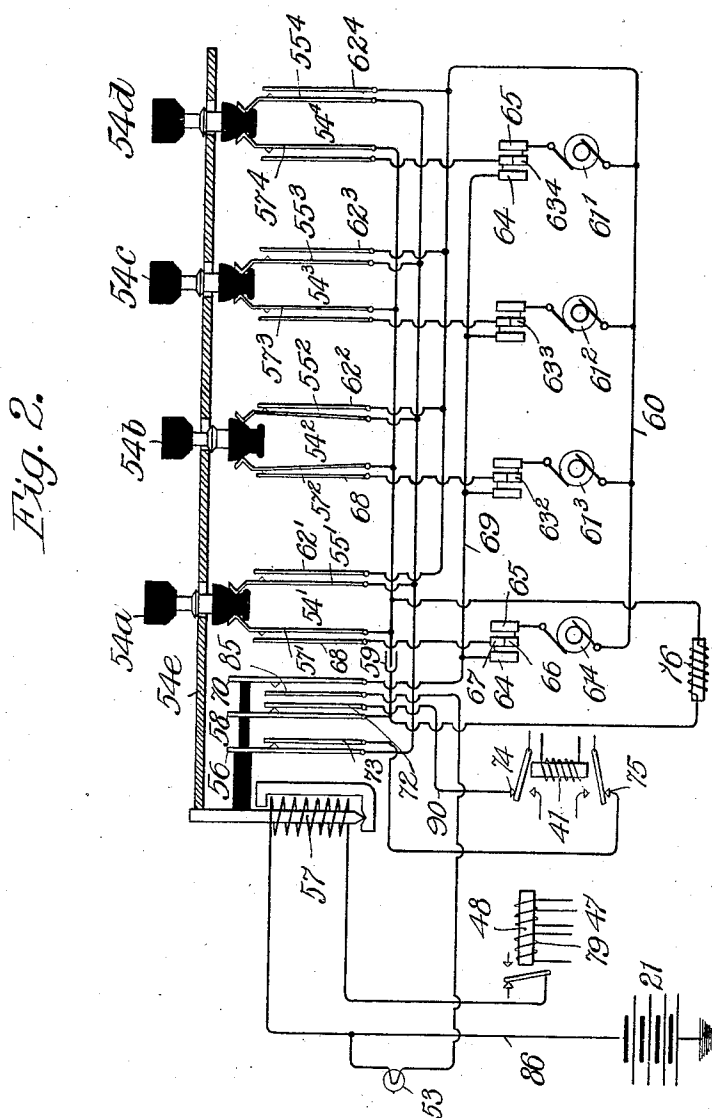
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2 SHEETS—SHEET 2.



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TELEPHONE-EXCHANGE 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 E. HAGUE, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, 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 particularly to the central exchange arrangement of trunk line systems, and its object is to provide means whereby the local exchange operator making use of the trunk line may control the application of ringing current to the called subscriber connected with the main exchange.

My improved arrangement is particularly adaptable when used in connection with automatic ringing systems, and the trunk operator ascertaining the required connection sets the corresponding selective key whereafter the application of the corresponding ringing current to the subscriber's line is controlled by the local exchange operator.

The details of my invention will be best understood by reference to the accompanying drawing, wherein

Figure 1 diagrammatically shows a trunk circuit arrangement at the main exchange and the operator's cord circuit arrangement at the local exchange, and also the connection of the automatic selective ringing mechanism with the trunk circuit, and Fig. 2 shows the mechanical connection between the several selective ringing keys and the armature of the relay used to retain any of such keys in operated position until the called subscriber responds.

Substation A as shown in Fig. 1 is of the local battery type provided with the ordinary telephonic apparatus comprising switch hook 1, receiver 2, transmitter 3, battery 4, signal bell 5 and the calling generator 6 connected in bridge of the line limbs *a*, *b*, the line limbs terminating normally at the exchange in the springjack *s* and the line indicator 7. The cord circuit at the local exchange L terminates in plugs 8 and 9, tip and sleeve contacts of the plug 8 being connected through tip and sleeve strands 10 and 11, respectively, with the operator's side of the operator's key K, while the tip and sleeve

contacts of the plug 9 connect through cord strands 12 and 13, respectively, with the ringing-side of the operator's key K. Actuation of the operator's side of the key will connect the operator's talking set O in bridge of the cord strands, and actuation of the ringing side of the key will connect the generator G in bridge of the cord strands 12 and 13. Auxiliary contacts 14 and 15 are provided, respectively, for the plugs 8 and 9, both connected through conductor 16 with ground E. A supervisory relay 17 is connected in bridge of the strands 12 and 13 and controls a local supervisory circuit comprising the battery 18 and supervisory lamp 19.

The substation B' connected with the main exchange is of the common battery type provided with the receiver hook 1', receiver 2', transmitter 3' and signal bell 5', the signal bell being bridged across the line in series with a condenser 20, the substation being normally connected through party line limbs *a'*, *b'* with the terminals of the common battery 21 and including the windings of a line relay 22 and the armatures 23 and 24 of the cut off relay 25. The line relay controls the local circuit for the indicating lamp 26. Three other party substations B², B³, B⁴ are shown also connected across the line limbs *a'*, *b'* and are provided with similar apparatus as that shown at the substation B'.

The trunk cord circuit T terminates at one end in a plug 27 for connection with the multiple jacks 28 and 29 connected with the substation B' and at its other end terminates in a jack 30 for connection with the plug 9 at the local exchange. The trunk cord circuit is divided into two conductively separated, but inductively associated, sections T' T, the tip and sleeve contacts of the springjack 30 being connected through the windings 31 and 32 of the repeating coils 33 and 34, respectively, a condenser 35 being connected between these windings. The tip and sleeve contacts of the plug 27 are adapted for connection through the windings 36 and 37 of the repeating coils, a condenser 38 being included between these windings. The continuity of the sleeve strand of the section T' is normally discontinuous at the contact 39 and armature 40 of the relay 41, and the tip strand of this section is normally

discontinuous at the contact 42 and a second armature 43 of this relay, this tip strand being normally also discontinuous at the armature 44 and contact 45 for the relay 46.

5 The winding 47 of the relay 48 is in series with the condenser 49 in a circuit bridged across the strands of the section T. The armature 50 for this relay normally engages the back contact 51 connected with one terminal of the relay 41. The armature 52 of the relay 46 controls the current supply to the trunk circuit supervisory lamp 53. The automatic ringing arrangement is shown at the top of the drawing and the mechanical arrangement and relations of the parts thereof may be as described below. This ringing mechanism is provided with a plurality of selective keys 54¹, 54², 54³ and 54⁴. The actuating springs 55¹, 55², 55³ and 55⁴ of these keys are connected together and with the armature 56 of the locking relay 57, while the actuating springs 57¹, 57², 57³ and 57⁴ of the keys are connected together and with the armature 58 of the relay 57 through the condenser 59. A common conductor 60 connects with one terminal of the ringing current source 61¹, 61², 61³ and 61⁴ and with the contacts 62¹, 62², 62³ and 62⁴, associated with the switch springs 55¹, 55², 55³ and 55⁴, respectively. The current interrupters 63¹, 63², 63³ and 63⁴ are associated with the respective keys, each comprising two conductors 64 and 65 and a middle ring composed of segments 66 and 67, the segment 67 of each interrupter being connected with the ring 65 thereof and with the contact 68 of the respective key. The segment 66 of each interrupter is connected with the ring 64 thereof and with a common conductor 69 connecting with a second armature 70 controlled by the relay 57 and with the contact 71 for the armature 52 of the relay 46. The other terminal of each of the generators 61¹, 61², 61³ and 61⁴ connects with the ring 65 of the corresponding interrupter, and upon actuation of a selective key the corresponding generator will be connected through the key with the armatures 56 and 58 of the relay 57, the alternate contacts 72 and 73 of the armatures 58 and 56, respectively, being connected with the alternate contacts 74 and 75, respectively, of the relay 41.

A controlling relay 76 is bridged about the condenser 59, and controls an armature 77 whose contact 78 is connected with one terminal of an auxiliary winding 79 for the relay 48, the other terminal of this winding connecting with the front contact 80 for the armature 50.

60 Let us suppose that the subscriber at substation A desires connection with the subscriber at party substation B'. Subscriber at substation A upon actuation of the generator 6 causes actuation of the indicator 7 at the local exchange, and the local operator

upon insertion of the plug 8 into the jack s actuates her key to connect her talking set O so she may ascertain the connection desired. This desired connection is communicated to the trunk operator through order circuits in the well known way, but which circuits are here not shown, forming no part of this invention. The trunk operator immediately inserts the calling plug 27 into one of the multiple jacks 28 and 29 and sets the selective key 54¹ connected with the generator 61¹ whose current is of such character as to actuate only the signal bell at substation B' upon being sent into the line, and the trunk operator also notifies the local operator which trunk line she is to use. Upon insertion of the plug 27 in the spring-jack circuit is closed from the negative side of battery 21, through conductor 81, through relay 46 to the sleeve strand and contact of plug 27, through conductor 82 connecting together the jack thimbles 83, through cut-off relay 25 to the positive side of battery 21. This causes energization of relays 25 and 46, relay 25 upon attraction of its armatures 23 and 24 serving to disconnect the line relay 22 and line lamp 26 from service, and relay 46 serving to attract the armature 44 to contact 45 and the armature 52 to contact 71, and this last connection closes a circuit extending from the positive side of battery 21 to the armature 52 through contact 71, to conductor 84, to armature 70 and contact 85 through supervisory lamp 53 and through conductor 86 back to the negative side of battery 21, the lamp 53 being thus illuminated. Upon connection of the plug 9 with the springjack 30 by the local exchange operator another circuit is closed as follows: From the negative side of battery 21 through conductor 81, through relay 41, through conductor 87, through contact 51 and armature 50 to conductor 88, to thimble 89 of springjack 30, through auxiliary contact 15, through conductor 16 to ground E and thence to the grounded positive side of battery 21. Relay 41 becoming energized draws its armatures 40 and 43 into engagement with the contacts 42 and 39, respectively, to make continuous the cord strands of the section T'. Upon connection of the plug 9 with the jack 30 circuit is also closed as follows: From the negative side of battery 21, through conductor 81, through relay 57, through conductor 88, through thimble 89 and contact 15 to ground E and to the grounded side of battery 21. Relay 57 thus energized draws its armatures into engagement with contacts 72 and 73 to extend the ringing current from the generator 61¹ to the contacts 74 and 75 which are at this stage disconnected from the armatures 40 and 43. Everything is in readiness now for the application of the selective ringing current to the party line leading to substation B' and

the local exchange operator actuates her ringing key to connect the generator G across the cord strands 12 and 13 whereby alternating current is sent through the spring-jack 30 and winding 47 of the relay 48 bridged across the cord strands of the section T. The relay 48 becoming energized attracts its armature 50 away from the contact 51 and into engagement with the contact 80 thereby closing circuit through winding 79 as follows: Negative side of battery 21, through conductor 81, through armature 77, contact 78, through winding 79, contact 80 and armature 50, conductor 88, thimble 89, contact 15 and conductor 16 to ground E and from there to the grounded side of battery 21, this local circuit maintaining energization of the relay 48 upon release of the ringing key by the operator at the local exchange, and this local circuit being once closed the control of the ringing current is beyond the local exchange operator.

The circuit through the relay 41 passes through the contact 51 and armature 50, but upon attraction of this armature the relay becomes deenergized and its armatures 43 and 40 again connect with the live contacts 74 and 75 connected with the generator 61¹, and this selective current immediately flows through the line limbs *a'*, *b'* and through the signal bell 5' at the substation B' to signal the subscriber, and this current continues until the subscriber answers, being interrupted regularly, of course, upon disconnection of the contact 68 from the live contact 67. The subscriber at substation B, on receiving a signal, removes his receiver from the hook thereby closing the following circuit: From the negative side of battery 21, conductor 81, relay 46, sleeve contact of springjack 27, sleeve contact of springjack 28, line limb *a'*, through the substation receiver and transmitter through line limb *b'*, through the tip contact of springjack 28, tip contact of plug 27, armature 44 and contact 45 of relay 46 to armature 43, through conductor 90, contact 72 and armature 58 of relay 57, through the relay 76 to key spring 57', contact 68, through segment 66 of the interrupter 63, to ring 64, to conductor 69, conductor 84, contact 71 and armature 52 of relay 46 and through conductor 93 to the positive side of battery 21. Relay 76 is adjusted to be unresponsive to alternating current, and will, therefore, not be actuated by the signaling current from the generator 61¹, and the condenser 59 is interposed in the ringing circuit to allow passage of alternating current through the ringing circuit but to deflect the direct current through the relay 76. Relay 76 then becoming energized, its armature 77 breaks connection with contact 78, thereby opening the local circuit through winding 79 of the relay 48 and the armature 50 upon release

again engages contact 51 to reclose the circuit through the relay 41, and the armatures 40 and 43 of said relay becoming attracted to the contacts 39 and 42 cause the cord strands to become continuous and the connected subscribers are connected for telephonic conversation.

When the local exchange operator connected with the springjack 30 and before substation B' was signaled, the supervisory relay 17 was connected in bridge of the battery 21 through the following circuit: From negative side of battery 21 to the armature 94 of the relay 95, through contact 96 to the inner terminal of repeating winding 32 through said winding, through the sleeve strand and sleeve spring of springjack 30, through the sleeve contact of plug 9 and sleeve strand 13, through relay 17, through tip strand 12 and tip of plug 9, through tip spring and tip strand of the jack 30, through repeating winding 31, through conductor 96', through contact 97 of armature 98 of relay 95 and to positive side of battery 21, thus causing the illumination of the lamp 19 controlled by the relay 17. Upon answering of the subscriber at substation B' in response to the calling signals, a circuit is traced as follows: From the negative side of battery 21, conductor 81, relay 46, sleeve strand and contact of plug 27, sleeve spring of jack 28, through line limb *a'*, through the substation B' to line limb *b'* to tip spring of jack 28, tip contact and strand of plug 27, through armature 43 and contact 42 of relay 41, through conductor 99, through relay 95 and to positive side of battery 21. Relay 95 thus becomes energized to attract its armatures to break the battery connection with the supervisory relay 17 which becomes deenergized to cause opening of the supervisory lamp circuit and the local exchange operator is notified that the called subscriber has answered. After conversation is completed between the connected parties, subscriber at substation B' hangs up his receiver and thereby opens the circuit, thus traced, with the result that relay 95 becomes deenergized to reconnect the battery with the supervisory relay 17 to again cause illumination of the supervisory lamp 19, and the operator receiving this signal withdraws the plug 9 from the jack 30. Withdrawal of this plug, however, breaks the circuit through the relay 57, and the armature 70 of said relay being released to reengage the contact 85 again causes closure of the circuit through the supervisory lamp 53 for the trunk operator, thus notifying this operator that conversation is completed, and she withdraws the plug 27 from the connected line.

As shown in Fig. 2, the keys 55¹, 55², 55³ and 55⁴ may be provided with locking mechanism also mechanically associated with the

relay 57, so that upon actuation of this relay 57 upon connection of plug 9 with the springjack 30, the depressed key 55¹ would be locked in its depressed position until de-energization of said relay upon disconnection of the plug 9, whereupon the depressed key would become released at the same time that the supervisory signal 53 would become illuminated at the close of conversation between the connected parties. After the local exchange operator disconnects the cord circuit from the springjack the cord circuits and selective signaling apparatus are again in normal condition ready for another connection.

It will be noticed that ring 64 of each interrupter is connected to ground when the plug 27 is inserted in a springjack, and through the following circuit: rings 64, conductors 69 and 84, contact 71 and armature 52 of relay 46 and conductor 93 to ground, thus before the subscriber on the party line answers there will be alternate pulsations of ringing current and ground applied to the line as the grounded segment 66 or the ringing current segment 67 becomes connected with contact 68 of the ringing key actuated. The line is, therefore, relieved of static charges after each application of ringing current, and is also relieved of such static charges when the subscriber unhangs his receiver, as the circuit through relay 76 must include the grounded segments 66 and 64 of the interrupter, and before alternating current can again be applied to the line, relay 41 will have become deenergized to withdraw the cord strands from the ringing current contacts 74 and 75, and when conversation then takes place there will be no interference from static or other disturbing influences.

By means of my invention a trunk operator, as before described, need only apply the trunk circuit to the line to be called, to notify the calling operator of the trunk to be used and to set the proper selective key, and thereafter need pay no attention to the connections until she receives the supervisory signals that conversation is completed, when she need only withdraw the plug 27 from the jack. After the trunk operator has established the necessary conditions for calling the required substation, the application of ringing current is controlled by the local exchange operator, but this control is only temporary, as connection of the generator G serves merely to initially energize relay 48, whereupon the local energizing circuit therefor maintains energization thereof and ringing current is applied, in the manner as before described, to the called line, these connections being performed entirely automatically, and the local exchange operator is advised by her supervisory lamp 19 of the conditions at the trunk station and of the called

substation line. By virtue of this arrangement, therefor, it is necessary only to establish the necessary conditions whereafter the actual calling of the subscriber and all of the supervisory and controlling steps are performed entirely automatically, thus relieving both the trunk and local operator of unnecessary work. At the same time the circuit arrangements are very simple and efficient. I do not wish, however, to be limited to the arrangement as shown, as changes may readily be made therein without departing from the scope of my invention, but

I claim as new and desire to secure by Letters Patent:

1. In a telephone exchange system, the combination with a central exchange, of telephone lines leading therefrom and terminating in substations, a cord circuit at the central exchange, a trunk circuit leading from the central exchange, a source of ringing current associated with the trunk circuit, a relay controlling the connection of said source of ringing current with the trunk line, means upon connection of the cord circuit with the trunk circuit for closing circuit through said relay to disconnect the source of ringing current from the trunk circuit, a second relay controlling the circuit through said first relay, and source of current associated with the cord circuit, connection of said source of current with the cord circuit when the cord circuit is connected with the trunk line causing actuation of said second relay to open the circuit through the first relay whereby the source of ringing current will be connected with the trunk circuit.

2. In a telephone exchange system, the combination with an operator's cord circuit at a central exchange, of a trunk line for connecting said exchange with a main exchange, a source of ringing current associated with the trunk circuit, a relay normally disposed to open the circuit from said ringing source, a second relay normally disposed to close the ringing circuit at another point, energizing circuits closed through said relays upon connection of the cord circuit with the trunk circuit whereby the first relay becomes energized to close the break in the ringing circuit and said second relay becomes energized to open the ringing circuit, a third relay controlling the circuit through said second relay, and a source of current associated with the cord circuit, connection of said source with the cord circuit causing current flow through said trunk line and third relay whereby said second relay circuit is opened and the ringing circuit again closed.

3. In a telephone exchange system, the combination with a central exchange, of substations connected therewith through telephone lines, a cord circuit at the central ex-

change for connecting with said lines, a trunk circuit leading from said exchange to a main exchange for connection at said main exchange with telephone lines leading to substations to be called, a source of ringing current at the main station associated with the trunk circuit, a relay controlling the continuity of the circuit from said source of ringing current to the trunk circuit, a second relay controlling the connection of the ringing circuit with the trunk circuit, energizing circuits for said relays closed upon connection of the cord circuit with the trunk circuit at the central exchange to cause the first relay to continue the ringing circuit to the cord circuit and said second relay to disconnect the ringing circuit from the trunk circuit, a third relay controlling the circuit through said second relay, a source of current associated with the cord circuit, connection of said source with the cord circuit and connected trunk line causing current flow through said third relay to open the circuit through the second relay whereby the source of ringing current is connected with the trunk circuit and with the line connected therewith to actuate substation apparatus, and means for again closing circuit through said second relay to disconnect the ringing source upon actuation of substation apparatus in response to the signaling current.

4. In a telephone exchange system, the combination with a central exchange, of substations connected therewith through telephone lines, a cord circuit at the central exchange for connecting with said lines, a trunk circuit leading from said exchange to a main exchange for connection at said main exchange with telephone lines leading to substations to be called, a source of ringing current at the main station associated with the trunk circuit, a relay controlling the continuity of the circuit from said source of ringing current to the trunk circuit, a second relay controlling the connection of the ringing circuit with the trunk circuit, energizing circuits for said relays closed upon connection of the cord circuit with the trunk circuit at the central exchange to cause the first relay to continue the ringing circuit to the cord circuit and said second relay to disconnect the ringing circuit from the trunk circuit, a third relay controlling the circuit through said second relay, a source of current associated with the cord circuit, connection of said source with the cord circuit and connected trunk line causing current flow through said third relay to open the circuit through the second relay whereby the source of ringing current is connected with the trunk circuit and with the line connected therewith to actuate substation apparatus, and a fourth relay having a circuit controlled by apparatus at the called substation and adapted upon actuation of sub-

station apparatus to again cause closure of the circuit through the second relay whereby said source of ringing current is disconnected from the trunk circuit.

5. In a telephone exchange system, the combination with a central exchange, of substations connected therewith through telephone lines, a cord circuit at the central exchange for connecting with said lines, a trunk circuit leading from said exchange to a main exchange for connection at said main exchange with telephone lines leading to substations to be called, a source of ringing current at the main station associated with the trunk circuit, a relay controlling the continuity of the circuit from said source of ringing current to the trunk circuit, a second relay controlling the connection of the ringing circuit with the trunk circuit, energizing circuits for said relays closed upon connection of the cord circuit with the trunk circuit at the central exchange to cause the first relay to continue the ringing circuit to the cord circuit and said second relay to disconnect the ringing circuit from the trunk circuit, a third relay controlling the circuit through said second relay, a source of current associated with the cord circuit, connection of said source with the cord circuit and connected trunk line causing current flow through said third relay to open the circuit through the second relay whereby the source of ringing current is connected with the trunk circuit and with the line connected therewith to actuate substation apparatus, a fourth relay, a local energizing circuit for said third relay controlled by said fourth relay to maintain energization of the third relay upon disconnection of the source of current from the cord circuit, and a circuit for said fourth relay controlled by apparatus at the called substation, actuation of said apparatus causing said fourth relay to be actuated to break the local energizing circuit whereby said second relay is again included in circuit and energized to disconnect the main circuit from the trunk line.

6. In a telephone exchange system, the combination with a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of ringing current at the main exchange, means controlled by the subexchange operator and operable independently of the connection of the trunk circuit with the line, for primarily establishing connection between the source of ringing current and the trunk line whereby ringing current passes through the connected telephone line to the substation to be called, automatic means for maintaining the flow of calling current to the called substation,

and means controlled by apparatus at the called substation for causing disconnection of the ringing circuit.

7. In a telephone exchange system, the combination with a trunk line for connection with telephone lines leading to substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism actuated upon connection of the cord circuit with the trunk line to continue the circuit from the ringing source to the trunk circuit, a second electromagnetic mechanism controlling the connection of said ringing circuit with the trunk circuit and actuated upon connection of the cord circuit with the trunk line to disconnect the ringing circuit from the trunk line, and a third electromagnetic mechanism controlled by the cord circuit operator and adapted upon actuation to change the circuit for the second electromagnetic mechanism to cause actuation thereof to connect the ringing circuit with the trunk line whereby ringing current will pass through the telephone line and substation connected with the trunk circuit.

8. In a telephone exchange system, the combination with a trunk line for connection with telephone lines leading to substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism actuated upon connection of the cord circuit with the trunk line to continue the circuit from the ringing source to the trunk circuit, a second electromagnetic mechanism controlling the connection of said ringing circuit with the trunk circuit and actuated upon connection of the cord circuit with the trunk line to disconnect the ringing circuit from the trunk line, a third electromagnetic mechanism controlled by the cord circuit operator and adapted upon actuation to change the circuit for the second electromagnetic mechanism to cause actuation thereof to connect the ringing circuit with the trunk line whereby ringing current will pass through the telephone line and substation connected with the trunk circuit, and a fourth electromagnetic mechanism controlling said third electromagnetic mechanism to restore the second electromagnetic mechanism circuit to its normal condition whereby the source of ringing current is again disconnected from the trunk line.

9. In a telephone exchange system, the combination with a trunk line for connection with telephone lines leading to substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading

to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism controlling the connection of said source with the trunk line and controlled by the connection of the cord circuit with the trunk line, a relay associated with the trunk circuit and responsive to alternating current, said relay controlling said electromagnetic mechanism, a source of alternating current for the cord circuit adapted upon connection of said cord circuit with the trunk line to be actuated to send current through the trunk line and relay connected therewith, additional electromagnetic mechanism associated with the trunk circuit and adapted to maintain energization of the relay, energization of said relay causing actuation of the electromagnetic mechanism to connect the ringing source with the trunk circuit and connected line, said additional electromagnetic means being adapted upon actuation of substation apparatus in response to signaling current to cause deenergization of the relay whereby the first electromagnetic mechanism may disconnect the signaling current from the trunk circuit.

10. In a telephone exchange system, the combination with a trunk circuit for connection with a called line, of a cord circuit for connecting said trunk circuit with calling lines, ringing current apparatus associated with the trunk circuit, electromagnetic mechanism for connecting said ringing current mechanism with the trunk circuit and connected line, a relay connected with the trunk line for controlling the circuit through said electromagnetic mechanism, a generator associated with the cord circuit, a winding for said relay responsive to current from said generator, a local energizing circuit for said relay for maintaining energization thereof after initial energization thereof by the alternating current, energization of said relay causing actuation of the electromagnetic mechanism to connect the ringing circuit with the trunk circuit and connected line, and additional electromagnetic mechanism controlling said local circuit, said additional electromagnetic mechanism being controlled by apparatus at the called substation and adapted upon actuation of said apparatus in response to signaling current to break the local circuit whereby said relay becomes deenergized and said first electromagnetic mechanism actuated to disconnect the ringing circuit from the trunk circuit.

11. In a telephone exchange system, the combination with a trunk line for connecting with lines leading to the substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading to calling substations, a source of ringing current associated with the trunk circuit,

electromagnetic mechanism controlling the connection of said source with the trunk circuit and line connected therewith, a relay associated with the trunk circuit for controlling the circuit for said electromagnetic mechanism, a circuit for said relay controlled by the cord circuit operator for causing actuation of said relay to control the electromagnetic mechanism, to connect the source of ringing current with the trunk circuit and line connected therewith, and a second circuit for said relay controlled by the connected substation on the called line, actuation of substation apparatus in response to signaling current causing said relay to be influenced to control the electromagnetic mechanism to disconnect the signaling current source from the trunk circuit.

12. In a telephone exchange system, the combination with a trunk circuit for connection with lines leading to substations to be called, of a cord circuit for connecting said trunk circuit with lines leading to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism for connecting said source with the trunk circuit and connected line, a relay for controlling the circuit through said electromagnetic mechanism, an alternating current energizing circuit for said relay controlled by the cord circuit operator to initially energize the relay to cause operation of the electromagnetic mechanism to connect the ringing current with the trunk circuit, a direct current energizing circuit for the relay closed upon energization thereof by the alternating current circuit to maintain energization of the relay upon opening of the alternating current circuit, said direct current circuit being controlled from the called substation, actuation of substation apparatus in response to signaling current causing opening of the direct current circuit, whereupon said relay becomes deenergized and the electromagnetic mechanism operated to disconnect the ringing source from the trunk circuit.

13. In a telephone central exchange system, the combination with a trunk line for connection with lines leading to substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism for controlling the connection of said ringing source with the trunk circuit and line connected therewith, a relay for controlling the circuit through said electromagnetic mechanism, an alternating current energizing circuit for said relay controlled by the cord circuit operator and adapted to initially energize the relay whereby the electromagnetic mechanism is controlled to connect the ring-

ing source with the trunk circuit, a local direct current energizing circuit for said relay for maintaining energization thereof after opening of the alternating current energizing circuit, additional electromagnetic mechanism controlling said local circuit, said additional electromagnetic mechanism being controlled from the called substation, actuation of apparatus at the substation responsive to signaling current causing said additional electromagnetic mechanism to open the local circuit whereby said relay becomes deenergized and the electromagnetic mechanism controlled to disconnect the signaling source from the trunk circuit.

14. In a telephone exchange system, the combination with a trunk line for connecting with lines leading to substations to be called, of a cord circuit for connecting said trunk line with telephone lines leading to calling substations, a source of ringing current associated with the trunk circuit, electromagnetic mechanism controlling the connection of said source with the trunk circuit and the line connected therewith, a circuit for said electromagnetic mechanism closed upon connection of said cord circuit with the trunk circuit whereby said electromagnetic mechanism is energized to disconnect the ringing source from the trunk circuit, a relay controlling the circuit for said electromagnetic mechanism, a source of current for the cord circuit, switching means controlled by the cord circuit operator for connecting said source of current to send current through said relay whereby said relay is actuated to open the circuit for the electromagnetic mechanism, said mechanism upon deenergization causing connection of the signaling source with the trunk circuit and line to be called.

15. In a telephone exchange system, the combination with a trunk circuit for connection with telephone lines to be called, of a cord circuit for connecting said trunk circuit with calling lines, a source of signaling current associated with the trunk circuit, electromagnetic mechanism controlling the connection of said source with the trunk circuit, a circuit for said electromagnetic mechanism closed upon connection of the cord circuit with the trunk line, whereby said mechanism becomes energized to disconnect the source of calling current from the trunk line, a relay controlling the circuit through said electromagnetic mechanism, an alternating current energizing circuit for said relay including part of the trunk circuit and part of the cord circuit and controlled by the cord circuit operator, said circuit upon closure causing initial energization of the relay to control the circuit for the electromagnetic mechanism to cause deenergization thereof and connection of the signaling source with

the trunk circuit, a local direct current energizing circuit for the relay, energization of the relay by the alternating current circuit causing closure of the direct current energizing circuit whereby energization of said relay is maintained, additional electromagnetic mechanism controlling said local circuit, and a circuit for said additional electromagnetic mechanism including apparatus at the called substation, actuation of said apparatus causing closure of the circuit through the additional electromagnetic mechanism whereby the local circuit is opened and the relay deenergized.

16. In a telephone exchange system, the combination of a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of ringing current at the main exchange, means controlled by the subexchange operator for primarily establishing connection between the source of ringing current and the trunk line whereby ringing current passes from the trunk line through the line to be called connected with the trunk line, automatic means for maintaining the flow of calling current to the called substation, and electromagnetic means for automatically causing disconnection of the source of ringing current from the trunk circuit when the called subscriber answers, the circuit for said electromagnetic means being normally open at the main exchange until closed by the actuation of substation apparatus in answer to the call.

17. In a telephone exchange system, the combination with a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of calling current at the main exchange, a source of direct current at the main exchange, means controlled by the subexchange operator for alternately connecting said ringing current source and the direct current source with the trunk circuit whereby when said trunk circuit is connected with a line to be called calling current and direct current will alternately pass through the line and substation to be called, and means controlled by apparatus at the called substation for causing disconnection of the ringing and direct currents from the trunk circuit.

18. In a telephone exchange system, the combination with a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of calling current at the

main exchange, a source of direct current at the main exchange, means controlled by the subexchange operator for alternately connecting said ringing current source and the direct current source with the trunk circuit whereby when said trunk circuit is connected with a line to be called calling current and direct current will alternately pass through the line and substation to be called, and means controlled by apparatus at the called substation and responsive only to direct current flow for causing disconnection of the ringing and direct currents from the trunk line.

19. In a telephone exchange system, the combination with a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of ringing current at the main exchange, a source of direct current at the main exchange, means at the main exchange controlled by the subexchange operator for closing circuits leading ringing current and direct current to the trunk circuit, additional electromagnetic mechanism at the main exchange controlled by the subexchange operator for connecting said ringing current and direct current circuits with the trunk circuit whereby ringing and direct currents will flow into the line and substation to be called when the trunk circuit is connected with the line, means for causing the ringing current and direct current to flow alternately, and additional electromagnetic means at the main exchange controlled by apparatus at the called substation and responsive only to the direct current flow to cause disconnection of both the direct and calling current circuits from the trunk circuit upon actuation of substation apparatus in response to the call.

20. In a telephone exchange system, the combination with a trunk circuit at a main exchange adapted for connection with lines leading to substations to be called, of a cord circuit at a subexchange for connecting said trunk line with lines leading to calling substations, a source of ringing current at the main exchange, a source of direct current at the main exchange, electromagnetic mechanism at the main exchange for closing circuits for leading direct and ringing current to the trunk circuit, said electromagnetic mechanism being controlled by the subexchange operator, a second electromagnetic mechanism at the main exchange also controlled by the subexchange operator for connecting the ringing and direct current circuits with the trunk circuit whereby ringing and direct currents will flow into the line and substation to be called when the trunk circuit is connected with the line, a third

electromagnetic mechanism associated with
both the ringing and direct current circuits
but responsive only to direct current, said
third electromagnetic mechanism being con-
5 trolled from the substation and operated
upon actuation of substation apparatus in
response to the call to affect the circuit of
the second electromagnetic mechanism to

disconnect the ringing and direct current
circuits from the trunk line.

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In witness whereof, I hereunto subscribe
my name this 20th day of April A. D., 1907.

CHARLES E. HAGUE.

Witnesses:

ALBERT C. BELL,
ARTHUR R. KAHL.