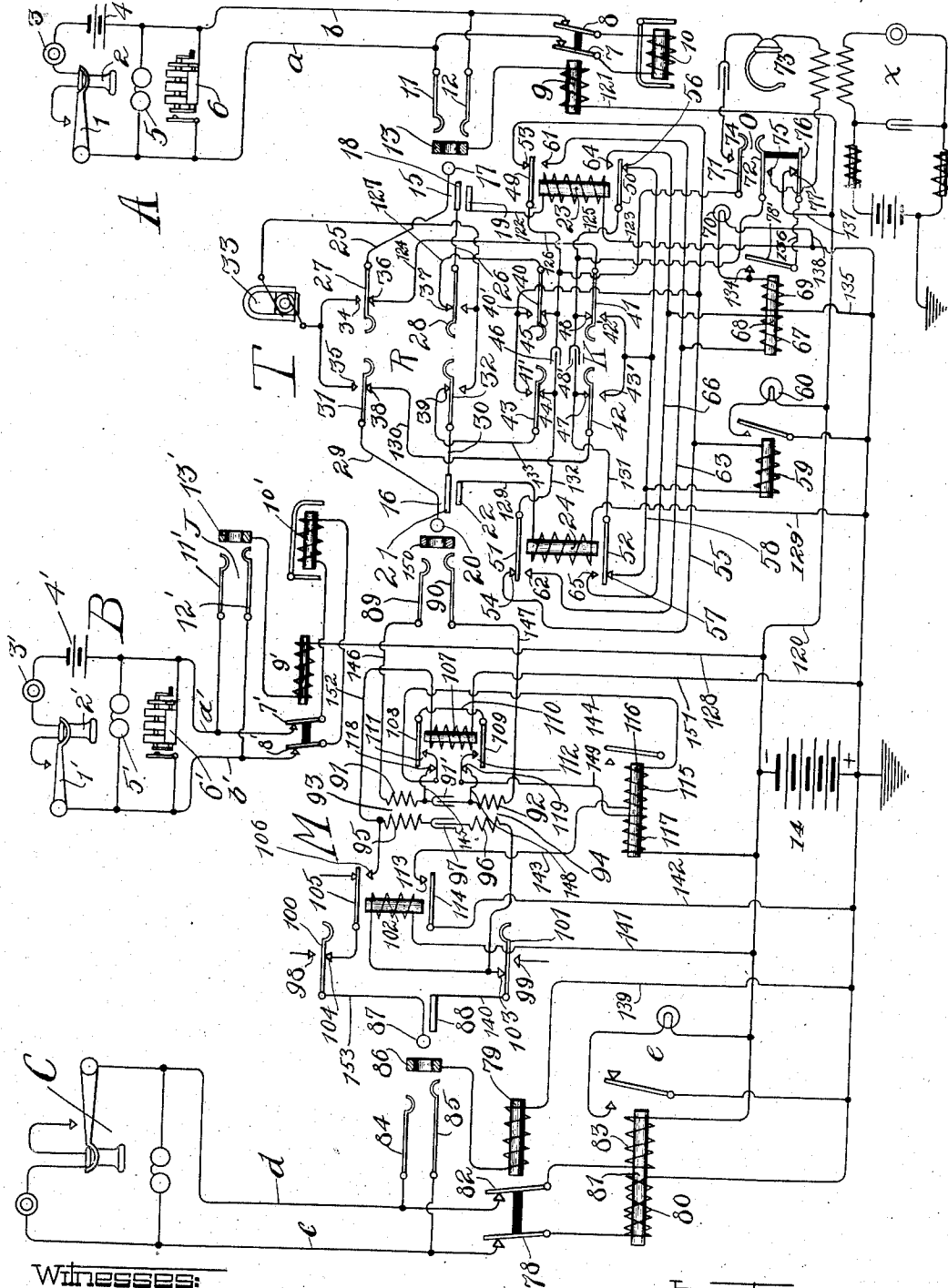


M. S. CONNER.  
TELEPHONE EXCHANGE SYSTEM.  
APPLICATION FILED JAN. 24, 1906.

901,685.

Patented Oct. 20, 1908.



Witnesses:

Arthur H. Boettcher,  
John Stahl.

Inventor

Merritt S. Conner

By

Charles A. Mower  
Attorney.

# UNITED STATES PATENT OFFICE.

MERRITT S. CONNER, OF ROCHESTER, NEW YORK, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

## TELEPHONE-EXCHANGE SYSTEM.

No. 901,885.

Specification of Letters Patent.

Patented Oct. 20, 1908.

Application filed January 24, 1906. Serial No. 297,553.

*To all whom it may concern:*

Be it known that I, MERRITT S. CONNER, 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 cord circuits and particularly to such as are used in long-distance or toll systems, and its object is to provide a universal cord circuit which may be utilized to make the different connections called for in such systems, and to provide supervisory means to meet the different conditions of operation.

In long-distance telephone service it is usual to provide the operator with cord pairs which are used to connect one toll line with another toll line and to provide a clearing-out signal which will respond to the signal current apparatus usually supplied to the different toll stations. This clearing-out or supervisory signal is usually a drop or relay which will respond to alternating current. In some cases it is desired to connect the long-distance line with a local or subscriber's station, which local stations are usually, under present practice, fed from a common battery at the central exchange. In this case it is usual to provide between the toll operator and the main switch-board, containing the local sub-stations, trunk lines, each terminating at the main board in a plug, and at the toll operator's position, in a jack. The toll operator, when a long-distance line is to be connected with a local line, makes use of these trunks, and is usually provided with some type of automatic signal which will indicate when the subscriber at the local station has answered.

The supervisory arrangement for connections of the above kind have heretofore been complicated and expensive, there being special devices and arrangements necessary for each of the above conditions of connection, and it is the object of my invention to combine these several supervisory features into a cord pair which may be used regardless of the connection and which will automatically

provide the proper clearing-out or supervisory signals to meet these different connections and conditions of signal.

My invention will be better understood by reference to the accompanying drawing which diagrammatically illustrates a main station and a toll station, and the various connections which will be required and the universal supervisory means therefor.

Connected with the toll exchange "T" are shown the sub-stations "A" and "B" each provided with the usual telephonic apparatus, comprising the switch hook 1, telephone receiver 2, transmitter 3 and battery 4, the signal bell 5, and the generator 6. The signal 5 and the generator are both connected in bridge of the line limbs *a* and *b*, the generator circuit, however, being normally open. At the toll exchange the line limbs *a*, *b*, are shown as normally connected, through the armatures 7 and 8 of the cut-off relay 9, with the indicating relay 10, and thus upon actuation of the sub-station generator the indicating relay will be actuated to convey a signal to the operator. The jack springs 11 and 12 are respectively connected with the line limbs *a* and *b*, while the jack thimble 13 connects through the winding of the supervisory relay 9 with the negative side of the common battery 14.

The toll cord circuit comprises the cord plugs 15 and 16, the plug 15 having the tip contact 17, the sleeve contact 18, and the thimble contact 19, and the plug 16 having the tip contact 20, the sleeve contact 21 and the thimble 22. The thimble contact 19 connects through the winding of the controlling relay 23 with the grounded positive side of the common battery 14, while the thimble contact 22 connects through the winding of the controlling relay 24 also with the positive side of the battery 14. The plug contacts 17 and 18 connect through strands 25 and 26 with the middle springs 27 and 28 of the ringing key "R", while the contacts 20 and 21 of the plug 16 connect through strands 29 and 30 with the middle springs 31 and 32 of the ringing key "R". A generator 33 of signaling current is connected with the alternate contacts 34 and 35, and upon actuation of either side of the ringing key ringing current may be sent through the corresponding cord strands and plug contacts into the

line connected with the plug. The middle springs 27 and 28 are normally in contact with the inner contacts 36 and 37, while the middle springs 31 and 32 are normally in contact with the inner contacts 38 and 39 of the key R. The inner springs 36 and 37 connect respectively with the middle springs 40 and 41 of an auxiliary key "K", while the inner springs 38 and 39 connect respectively with the middle springs 42 and 43 of the key "K". The inner contacts 44 and 45 of the key "K" are normally in contact with the middle springs and are connected together through a condenser 46; the inner springs 47 and 48 are normally connected with the middle springs 41 and 42 and are connected together through condenser 48'. Thus normally the tip cord strands 25 and 29 are continuous through the condenser 48' and the sleeve strands 26 and 30 are normally continuous through the condenser 46. The inner springs 45 and 48 are also connected respectively with the armatures 49 and 50 controlled by the controlling relay 23, and the inner springs 44 and 47 are also connected respectively with the armatures 51 and 52 controlled by the relay 24. The back contacts 53 and 54 of the armatures 49 and 51 respectively are connected together through the conductor 55, and the back contacts 56 and 57 of the armatures 50 and 52 respectively are connected together through the conductor 58, and across the conductors 55 and 58 is bridged the supervisory relay 59 controlling the local circuits for the supervisory lamp 60. The alternate contacts 40' and 41' are connected together and with the conductor 55, while the alternate contacts 42' and 43' are connected together and with the conductor 58. The front contacts 61 and 62 of the armatures 49 and 51 are connected together through the conductor 63 and the front contacts 64 and 65 of the armatures 50 and 52 respectively are connected together through the conductor 66. Across the conductors 63 and 66 is bridged the winding 67 of the supervisory relay 68. This relay 68 is also provided with a local circuit winding 69 for controlling the supervisory lamp 70.

The main springs 71 and 72 of the operator's key "O" are connected respectively with the inner springs 45 and 47 of the key "K" and the operator's receiver's circuit 73 is connected to the outer contacts 74 and 75 of this key. An additional spring 76 connects with the spring 72 and normally engages the contact 77, the spring 76 being connected with the armature 78' of the supervisory relay 68, and the contact 77 being connected with the negative side of the battery 14. The local circuits controlling the supervisory lamp 70 are normally continuous through the operator's key, but upon actuation of this key these circuits are broken upon disengagement of the contact 77 from

the auxiliary spring 76. The operator's transmitter circuit  $\alpha$  is inductively associated with the receiver's circuit as shown.

The sub-station "C" connects through the limbs  $c, d$ , with the main board "M". The limb  $c$  connects through the armature 78 of the cut-off relay 79 and through the winding 80 of the indicating relay 81, and with the positive side of the battery 14, while the limb  $d$  connects through the armature 82 of the cut-off relay and the winding 83 of the indicating relay and with the negative side of the battery 14. The line limbs connect also with the jack springs 84 and 85, the jack thimble 86 connecting through the cut-off relay 79 with the positive side of the battery 14. The indicating lamp circuit  $e$  is controlled by the indicating relay 81.

The trunk line at the board "M" terminates at one end in the tip and sleeve plug contacts 87 and 88 and at the other end terminates in the tip and sleeve jack springs 89 and 90. The cord circuit is divided into two conductively separate but inductively related sections, the jack springs 89 and 90 being connected together through the windings 91 and 92 of the repeating coils 93 and 94 respectively, with the condenser 91' interposed between the windings, while the tip and sleeve contacts 87 and 88 of the plug may be connected through the windings 95 and 96 of the repeating coils 93 and 94 respectively, a condenser 97 being interposed between the windings. The operator ringing circuit is connected with the alternate contacts 98 and 99 for the middle springs 100 and 101. The winding of a controlling relay 102 is connected with the negative side of the battery 14 and with the normal contact 103 for the middle spring 101. The normal contact 104 for the middle spring 101 connects with the armature 105 controlled by the relay 102, and the front contact 106 for the armature 105 is connected with the winding 95. The outer terminal of the winding 96 connects with the normal contact 103.

An additional controlling relay 107 is associated with the trunk circuit and connected with the contact 106 of the relay 102 and with the positive side of the battery 14. The armatures 108 and 109 controlled by this relay are connected directly together by the conductor 110. Upon energization of the relay the armature 108 connects with the contact 111, and the armature 109 connects with the contact 112, the contact 111 being connected with the contact 113 for the armature 114 of the controlling relay 102, this armature being connected with the positive side of the battery 14. The connection between the contacts 111 and 113 includes the winding 115 of the relay 116. The contact 112 of the relay 107 connects with the negative side of the battery 14 through another winding 117 for the relay 116. A contact 118 nor-

5 mally engages with the contact 111 and is connected with the inner end of the repeating coil winding 91, while the contact 119 normally engages with the contact 112 and is connected with the inner end of the repeating coil winding 92. Upon energization of the relay 107 the armatures thereof engage with the contacts 111 and 112 and cause disconnection of these contacts from the contacts 10 118 and 119 respectively.

Having thus secured the general disposition of the apparatus and circuits, the operation of this system becomes apparent. Supposing sub-station "A" desires connection 15 with toll sub-station "B", the subscriber at sub-station "A" actuates his generator to send an impulse through the indicating relay or drop 10, which will display a signal to the toll operator who then inserts plug 15 in the jack connected with the line leading to sub-station "A". Upon such connection the following circuit will be closed: from battery 14 through conductor 120, conductor 121, cut-off relay 9, jack thimble 13, plug contact 20 19, conductor 122, controlling relay 23 and through conductor 123 to the positive side of the battery. Upon closure of this circuit cut-off relay 9 becomes energized to withdraw its armatures 7 and 8 to disconnect the indicator 10 from the line and controlling relay 23 is energized to attract its armatures into engagement with the contacts 61 and 64. The winding 67 of the supervisory relay 68 connected with the conductors 63 and 66, 35 is thereupon connected in bridge of the cord strands and line limbs *a*, *b*, through the following circuit: line limb *a*, jack spring 11, tip contact 17, cord strand 25, key springs 27 and 36, conductor 124, springs 41 and 48 40 to key "K", conductor 125, armature 50 and contact 64 of relay 23, conductor 66, through winding 67 of the supervisory relay, through conductor 63 to contact 61 and armature 49 of the relay 23, conductor 126, springs 45 and 45 40 of the key "K", conductor 127, springs 37 and 28 of the ringing key "R", cord strand 26, sleeve contact 18, jack spring 12 and to line limb *b*, the circuit being ready to transmit ringing-off currents from the generator 50 at sub-station "A" upon cessation of conversation.

Having inserted the plug the operator actuates the operator's key "O" to connect herself in circuit to ascertain the connection 55 desired by the calling sub-station, and this being the sub-station "B", she inserts the plug 16 into the jack J corresponding to sub-station "B". Upon such connection the following circuit will be closed: from battery 60 14, through conductor 128, through cut-off relay 9' to jack thimble 13', to the plug contact 22, conductor 129, controlling relay 24 and through conductor 129' to battery 14. Cut-off relay 9' is actuated to disconnect the 65 indicating relay 10' from the line, while con-

trolling relay 24 is energized to attract its armatures into engagement with contacts 62 and 65 to connect the winding 67 in bridge also of the cord strands 29 and 30 and the line leading to sub-station "B", the circuit 70 being as follows: line limb *a'* to jack spring 11', plug tip 20, cord strand 29, through the ringing key to conductor 130, through key "K" to conductor 131, through armature 52 and contact 65 of the relay 24, through conductor 66, through winding 67 to conductor 75 63, through contact 62 and armature 51 of the relay 24, through conductor 132, through the key "K", conductor 133, through key "R" to cord strand 30, to sleeve contact 21, 80 through jack spring 12' and to line limb *b'*. The supervisory relay 68 will be thus in readiness to be actuated upon actuation of the generator at the sub-station "B" when conversation is closed. Having thus con- 85 nected with the desired line, the operator actuates the ringing key "R" to send ringing current from the generator 33 to the contact 35, cord strand 29, tip 20, jack spring 11', through the line limb *a'*, through the 90 bells 5' at sub-station "B", through line limb *b'*, through jack spring 12', plug sleeve contact 21, cord strand 30, contact 35, back to the generator 33.

Upon removal of the receiver from the 95 hook by the subscriber at sub-station "B", this sub-station and the calling station "A" will be in connection for telephonic conversation through the following path: line limb *a'*, through the spring jack and associated 100 plug to cord strand 25, through conductor 124, springs 41 and 47 of the key "K", through the condenser 48', through springs 47 and 42, through conductor 130, through ringing key "R", cord strand 29, through 105 the plug and associated spring jack to line limb *a'*, through the sub-station telephonic apparatus back to line limb *b'*, through the spring jack and associated plug to cord strand 30, through key "R", conductor 133, 110 springs 43 and 44 to key "K", through condenser 46, through springs 45 and 40, conductor 127, through key "R", through cord strand 26, through the associated plug and spring jack to line limb *b* and through the 115 telephonic apparatus at sub-station "A" back to line limb *a*. Upon cessation of conversation the subscriber either at sub-station "A" or "B" causes actuation of the generator thereat to send ringing-off current 120 through the line and circuits at the central station before traced to cause energization of the supervisory relay 68 by means of the winding 67. This generator current is alternate in character and the local winding 69 125 heretofore described is therefore provided to maintain energization of the supervisory relay. Upon actuation of this relay by the winding 67, its armature 78' is attracted to engage the contact 134 whereby current will 130

flow as follows: positive side of battery 14, through conductor 135, winding 69, contact 134 and armature 78' to conductor 136, through contacts 76 and 77 to operator's key and through conductors 137 and 120 back to the battery. Upon attraction of this armature another local circuit will be closed through the supervisory lamp 70 as follows: positive side of battery 14 through conductor 138, lamp 70, contact 134 and armature 78' to conductor 136, contacts 76 and 77 of operator's key and through conductors 137 and 120 back to the battery. Upon receiving this signal the operator withdraws both plugs from the jacks. Although the local circuit controlling the lamp 70 still remains closed after withdrawal of the plugs, the operator can easily restore the circuit by tapping the operator's key to open the contacts 76 and 77, whereupon relay 68 becomes energized and the circuits are all again in their normal condition.

If the calling sub-station "A" had desired connection with a local common battery station—for instance "C"—the toll operator would notify the trunk operator of the desired connection and the trunk operator would inform her of the trunk to be used and would insert the plug of this trunk into the spring jack connected to the sub-station "C". Immediately upon connection of this plug in the jack current will flow from the positive side of battery 14, through conductor 139 to relay 79, through jack thimble 86, sleeve contact 88, cord strand 140, springs 101 and 103 to relay 102, through conductor 141 to the negative side of battery 14, the cut-off relay 79 upon energization disconnecting the indicating relay 81 from circuit. Relay 102 upon energization attracts its armature 105 to the contact 106 to complete the cord circuit and attracts armature 114 to contact 113 to close the following circuit: from positive side of battery 14 to conductor 142, to armature 114 and contact 113, conductor 143, winding 115 of the supervisory relay 116, conductor 144, contacts 118 and 111 of the relay 107, conductor 145 to repeating coil winding 91, cord strand 146, tip spring 89, tip 20 of plug 16, cord strand 29 through key "R" to conductor 130, through key "K" to conductor 131, through armature 52 and contact 57 of relay 24 to conductor 58, through supervisory relay 59, through conductor 55, through contact 54 and armature 51 of relay 54, through conductor 132, through key "K", through conductor 133, through key "R" to cord strand 30, to jack spring 90, to cord strand 147, through repeating coil winding 92, through conductor 148, through contacts 119 and 112 of the relay 107, through conductor 149 and through winding 117 of the supervisory relay 116 to the negative side of battery 14, the super-

visory relays 116 and 59 becoming energized and the local circuit, including the lamp 60 at the toll board, becoming closed to indicate to the toll operator that connection with the line to be called has been made. It will be noted that the relay 24 does not become energized upon connection of the toll plug 16 with the trunk jack, as the thimble 150 of this jack is dead. The trunk operator may send signaling current to ring the sub-station "C" by actuation of the springs 100 and 101 into engagement with the contacts 98 and 99, which may be connected with some source of ringing current, or the toll operator upon illumination of the lamp 60 may actuate her key "R" to send current from the generator 33 into and through the trunk cord "M" to ring the sub-station "C". Upon removal of the receiver from the hook at sub-station "C" in answer to the ringing current, the circuit will be closed through the relay 107 as follows: positive side of battery 14, conductor 151, relay 107, conductor 152, contact 106 and armature 105, through springs 104 and 100, cord strand 153, through the plug and associated jack, line limb *d*, through receiver circuit at the sub-station "C", through line limb *c*, through the spring jack and associated plug to sleeve strand 140, to spring 101 and 103, through relay 102 and conductor 141 to battery 14; relay 107 becoming energized attracts its armatures to engage the contacts 111 and 112 and to break connection between these contacts through the contacts 118 and 119. The relay 59 at the toll station will now be disconnected from circuit and the lamp controlled thereby extinguished to indicate to the operator that the called sub-station "C" has answered. Circuit through the windings 117 and 115 of the trunk supervisory 116, however, will be maintained through the conductor 110 connecting the armatures of the relay 107, the circuit being as follows: negative side of battery 14, winding 117, conductor 149, armature 109, conductor 110, armature 108, contact 111, conductor 144, winding 115, conductor 143 and through armature 114 of relay 102, through conductor 142 to the positive side of battery 14. The connected subscribers are now in connection for telephonic conversation.

As before described the condensers 46 and 48' complete the telephonic circuit through the toll cords and telephonic currents from the sub-station "A" pass into the trunk line and through the repeating windings 91 and 92 to be repeated into the windings 95 and 96 and to the sub-station "C", and vice versa voice currents from sub-station "C" pass through repeating windings 95 and 96 and are repeated into the windings 91 and 92 and through the toll cords to substation "A" and the condensers 46 and 48' serving also

to prevent the constant current which operates relay 59 from passing out on the line to the sub-station "A".

Upon completion of conversation the subscriber at sub-station "A" upon actuation of his generator sends clearing-out current which results in the actuation of supervisory relay 68 and the supervisory lamp controlled thereby, as before described. At sub-station "C" it is necessary only to hang the receiver on the hook, whereupon the circuit before traced through the sub-station and through the relay 107 is opened and the relay becomes deenergized and its armatures and contacts restored to their normal position so that current will again flow, as before described, through the toll supervisory relay 59 to cause the lamp 60 to glow, which indicates to the toll operator that the apparatus at sub-station "C" has been restored to normal.

The operator's key is normally connected across the plug strands, and the operator, upon actuation of the key, is normally connected with both sub-stations. It is sometimes desirable, however, that she connect with one subscriber only, as, for instance, where the connected subscribers fail to understand each other, when she must connect first with one subscriber and then with the other to assist in transmitting the messages. It is for this purpose that the auxiliary key "K" is provided. Upon actuation of the key "K" to spread the springs 40 and 41, the connection between the operator's set and the cord strands leading to the sub-station "A" is broken and the operator is then connected only with sub-station "B". When the other side of the key is actuated the operator will be connected with sub-station "A" only. As the supervisory relay 68 is also connected with the cord strands through the contacts of key "K", this relay will also be disconnected from the same side with the operator's set. It is, however, desirable that supervision of the disconnected line should be maintained, and this temporary supervision is performed by the relay 59, which upon actuation of either side of the key "K" is connected in bridge of the cord strands on that side and the operator by observing the lamp 60 can then receive any messages from sub-station "A" while she is connected only with sub-station "B".

I thus provide a system of cord-circuit connections and arrangements which is greatly simplified over the systems heretofore used, in that less apparatus is used and each of the apparatus which is used being adapted to perform several functions. The toll station operator has complete supervision at all times, whether a toll sub-station connects with another toll sub-station, or a toll sub-station is connected with a common

battery or local station, or for any other connections through her cord circuit.

As change may readily be made in the detail arrangement of the apparatus and circuits, I do not wish to be limited to the exact arrangement here shown, but

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

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 exchange, a supervisory relay normally disconnected from the cord circuit, and a controlling relay for controlling the connection of said supervisory relay with the cord circuit, connection of the cord circuit with a line causing change in the circuit conditions for the controlling relay whereby said relay is actuated to connect the supervisory relay with the cord circuit.

2. 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 exchange, a supervisory relay normally disconnected from the cord circuit, a controlling relay for controlling the connection of said supervisory relay with the cord circuit, connection of the cord circuit with a line causing change in the circuit conditions for the controlling relay whereby said relay is actuated to connect the supervisory relay with the cord circuit, and a source of current at the substation adapted for connection with the line to send current through the supervisory relay when said relay is connected with the cord circuit.

3. 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 exchange, a supervisory relay normally disconnected from the cord circuit, a controlling relay for controlling the connection of said supervisory relay with the cord circuit, connection of the cord circuit with a line causing change in the circuit conditions for the controlling relay whereby said relay is actuated to connect the supervisory relay with the cord circuit, a source of alternating current at the substations adapted upon actuation to send current through said supervisory relay when said relay is connected with the cord circuit, and a local energizing circuit for maintaining energization of the supervisory relay upon cessation of current flow from said source at the substation.

4. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a cord circuit at the exchange, a supervisory relay normally disconnected from the cord circuit, a relay

for controlling said supervisory relay, and means adapted upon connection of the cord circuit with the line for closing a local circuit through said controlling relay to cause  
5 actuation thereof to connect the supervisory relay with the cord circuit.

5. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a cord circuit at the exchange, a supervisory relay normally disconnected from the cord circuit, a relay for controlling said supervisory relay, means adapted upon connection of the cord circuit with the line for closing a local circuit through said controlling relay to cause actuation thereof to connect the supervisory relay with the cord circuit, and a source of current at the substation adapted for connection with the line to send current through the supervisory relay when said relay is connected with the cord circuit.

6. In a telephone exchange system, the combination with a central exchange, of a telephone line leading therefrom and terminating in a substation, a cord circuit at the exchange, a supervisory relay normally disconnected from the cord circuit, a relay for controlling said supervisory relay, means adapted upon connection of the cord circuit with the line for closing a local circuit through said controlling relay to cause actuation thereof to connect the supervisory relay with the cord circuit, a source of alternating current at the substations adapted upon actuation to send current through said supervisory relay when said relay is connected with the cord circuit, and a local energizing circuit for maintaining energization of the supervisory relay upon cessation of current flow from said source at the substation.

7. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting telephone lines together, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, and means adapted upon connection of the cord circuit with the line for causing a change in the circuit conditions of said controlling relay to cause actuation thereof to connect the supervisory relay in bridge of the telephonic limbs of the cord circuit.

8. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting telephone lines together, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, means adapted upon connection of the cord circuit with the line for causing a

change in the circuit conditions of said controlling relay to cause actuation thereof to connect the supervisory relay in bridge of the telephonic limbs of the cord circuit, and a source of current at the substation adapted for connection with the line to send current through the supervisory relay when said relay is connected with the cord circuit.

9. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting telephone lines together, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, means adapted upon connection of the cord circuit with the line for causing a change in the circuit conditions of said controlling relay to cause actuation thereof to connect the supervisory relay in bridge of the telephonic limbs of the cord circuit, a source of alternating current at the substations adapted upon actuation to send current through said supervisory relay when said relay is connected with the cord circuit, and a local energizing circuit for maintaining energization of the supervisory relay upon cessation of current flow from said source at the substation.

10. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different telephone lines together, a supervisory relay for said cord circuit normally disconnected therefrom, a controlling relay for said supervisory relay, and an auxiliary contact for said cord circuit, said auxiliary contact engaging with the spring jack thimble upon connection of the cord circuit with the line whereby a circuit is closed through the controlling relay to cause the supervisory relay to be connected in bridge of the cord telephone limbs of the cord circuit, said supervisory relay being thereafter controlled by substation apparatus.

11. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different lines together for conversation, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, an indicating signal normally connected with the line limbs, a cut off relay for controlling the connection of said indicating signal with the line limbs, and a local circuit closed upon connection of the cord circuit with the line, said local circuit including said cut off relay and said controlling relay to cause actuation thereof, said cut off relay upon actuation causing the indicating signal to be disconnected from the line limbs and actuation of the controlling



relay causing said supervisory relay to be connected with the cord circuit to be thereafter controlled by substation apparatus.

12. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different lines together for conversation, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, an indicating signal normally connected with the line limbs, a cut off relay for controlling the connection of said indicating signal with the line limbs, and a local circuit closed upon connection of the cord circuit with the line, said local circuit including said cut off relay and said controlling relay to cause actuation thereof, said cut off relay upon actuation causing the indicating signal to be disconnected from the line limbs, actuation of said controlling relay causing said supervisory relay to be connected in bridge of the telephonic limbs of the cord circuit and the line limbs connected therewith, said supervisory relay being thereafter controlled by substation apparatus.

13. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different lines together for conversation, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, an indicating signal normally connected with the line limbs, a cut off relay for controlling the connection of said indicating signal with the line limbs, and a local circuit closed upon connection of the cord circuit with the line, said local circuit including said cut off relay and said controlling relay to cause actuation thereof, said cut off relay upon actuation causing the indicating signal to be disconnected from the line limbs, actuation of said controlling relay causing said supervisory relay to be connected with the cord circuit and line connected therewith, and a source of current at the connected substation adapted to send current through said line and connected supervisory relay.

14. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different lines together for conversation, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, an indicating signal normally connected with the line limbs, a cut off relay for controlling the connection of said indicating signal with the line limbs, a local circuit closed upon connection of the cord circuit with the line, said local circuit including said cut off relay and said con-

trolling relay to cause actuation thereof, said cut off relay upon actuation causing the indicating signal to be disconnected from the line limbs, actuation of said controlling relay causing said supervisory relay to be connected with the cord circuit, a source of alternating current at the connected substation, actuation of said source causing current to travel through the line and supervisory relay connected with the cord circuit, a supervisory signal circuit controlled by said supervisory relay and closed upon energization thereof, and a local circuit for said supervisory relay for maintaining energization thereof and closure of the supervisory signal circuit upon disconnection of said source at the substation.

15. In a telephone exchange system, the combination with a central exchange, of a substation connected therewith through a telephone line, a cord circuit for connecting different lines together for conversation, a supervisory relay normally disconnected from the cord circuit, a controlling relay for said supervisory relay, an indicating signal normally connected with the line limbs, a cut off relay for controlling the connection of said indicating signal with the line limbs, a local circuit closed upon connection of the cord circuit with the line, said local circuit including said cut off relay and said controlling relay to cause actuation thereof, said cut off relay upon actuation causing the indicating signal to be disconnected from the line limbs, actuation of said controlling relay causing a winding of said supervisory relay to be connected in bridge of the telephonic limbs of the cord circuit and with the limbs of the connected telephone line, a generator at the substation for sending an impulse through the line and supervisory relay winding connected with the cord circuit, a supervisory signal circuit closed upon initial energization of the supervisory relay, and a local circuit for said supervisory relay for maintaining energization thereof upon disconnection of the generator from the line.

16. In a telephone exchange system, the combination with a central exchange, of sub-stations connected therewith and with telephone lines, a cord circuit provided with plugs for connection with springjacks connected with the lines, a supervisory relay normally disconnected from the cord circuit, a controlling relay associated with each plug for controlling said supervisory relay, connection of a plug with a line causing closure of a local circuit through the corresponding controlling relay to connect the supervisory relay with the cord circuit, and a source of current for supplying said local circuit.

17. In a telephone exchange system, the combination with a central exchange, of sub-stations connected therewith through tele-



phone lines, a cord circuit provided with plugs for connecting lines together, a supervisory relay normally disconnected from the cord circuit, a controlling relay associated with each plug of the cord circuit, connection of said plugs with springjacks connected with telephone lines to be connected causing closure of a local circuit to reach the controlling relay whereby said supervisory relay is connected with the cord circuit, a source of current for supplying said local circuit, and means at the connected substations for controlling said supervisory relay after connection thereof with the cord circuit.

18. 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, a supervisory relay normally connected with the cord circuit, a second supervisory relay normally disconnected from the cord circuit, and means upon connection of said cord circuit with a telephone line causing disconnection of the first supervisory relay from the cord circuit and connection of the second supervisory relay with the cord circuit.

19. In a telephone exchange system, the combination with a cord circuit for connecting the telephone lines, of a supervisory relay normally connected to the cord circuit, a second supervisory relay normally disconnected from the cord circuit, and means adapted upon connection of said cord circuit with a telephone line to cause disconnection of the first relay from the cord circuit and connection with the second supervisory relay in bridge of the cord circuit conductors.

20. In a telephone exchange system, the combination with a cord circuit for connection with telephone lines, of two supervisory relays associated with the cord circuit, a controlling relay normally disposed to connect one of said supervisory relays with the cord circuit and to disconnect the other supervisory relay from the cord circuit, said controlling relay being actuated upon connection of the cord circuit with a line to disconnect the first supervisory relay from the cord circuit and to connect the second supervisory relay therewith.

21. In a telephone exchange system, the combination with a cord circuit for connecting telephone lines together, of a supervisory relay normally connected in bridge of cord circuit conductors, a second supervisory relay normally disconnected from the cord circuit, and a controlling relay for disconnecting said first supervisory relay from the cord circuit and for connecting said second supervisory relay in bridge of cord circuit conductors.

22. In a telephone exchange system, the combination with a cord circuit for connecting telephone lines together, of a supervisory relay normally connected in bridge of cord circuit conductors, a second supervisory relay normally disconnected from the cord circuit, and a controlling relay adapted upon connection of the cord circuit with a line for causing disconnection of the first supervisory relay from the cord circuit and connection of the second supervisory relay in bridge of cord circuit conductors.

23. In a telephone exchange system, the combination with a cord circuit terminating in two plugs, of cord strands connecting said plugs, a condenser in each cord strand dividing the cord circuit into two conductively distinct sections, a supervisory relay normally connected with both sections, a second supervisory relay normally disconnected from either section, and a controlling relay associated with each section, connection of a plug with a telephone line causing actuation of the corresponding controlling relay to disconnect the first supervisory relay from the corresponding section and to connect the second supervisory relay with said section.

24. In a telephone exchange system, the combination with a cord circuit terminating in two plugs, of tip and sleeve strands connecting said plugs, condensers for dividing said cord circuit into two conductively distinct sections, a supervisory relay normally connected in bridge of the cord strands of both sections, a second supervisory relay normally disconnected from the cord circuit, and a controlling relay associated with each cord section, connection of a plug with a telephone line causing actuation of the corresponding controlling relay to disconnect the first supervisory relay from the cord circuit and to connect the second supervisory relay in bridge of the cord strands of the corresponding section.

25. In a telephone exchange system, the combination with a cord circuit for connecting telephone lines together, of two plugs for said cord circuit, tip and sleeve strands connecting said plugs together, condensers for dividing said cord circuit into two conductively distinct sections, a controlling relay for each section, a source of current, a supervisory relay normally connected in bridge of both cord sections, two contacts of the controlling relays, a second supervisory relay normally disconnected from the cord circuit, connection of a plug with a line causing closure of a circuit including said source of current and the corresponding controlling relay whereby said relay is actuated to disconnect the first supervisory relay from the corresponding section and to connect the second supervisory relay in bridge of said section.

26. In a telephone exchange system, the combination with a cord circuit for connecting telephone lines together, two plugs for said cord circuit, tip and sleeve strands connecting said plugs together, condensers for dividing said cord circuit into two conductively distinct sections, springjacks connected with the telephone lines, a third contact for each plug, a springjack contact for connection with said auxiliary contacts, a controlling relay for each section connected with the corresponding third contact, a source of current, a supervisory relay normally connected with both sections of the cord circuit through contacts of said controlling relays, a second supervisory relay normally disconnected from the cord circuit by said controlling relays, connection of a plug with a springjack causing closure of a local circuit through said source of current and corresponding controlling relay, whereby said controlling relay is actuated to disconnect the first supervisory relay from the corresponding section and to connect the second supervisory relay with said section, said second supervisory relay being thereafter controlled by apparatus at the connected substation.

27. In a telephone exchange system, the combination with a central exchange, of telephone lines leading therefrom and terminating in substations, a cord circuit for connecting telephone lines together, a supervisory relay normally disconnected from the cord circuit, means adapted upon connection of the cord circuit with a line for connecting said supervisory relay with the cord circuit, operator's telephonic apparatus normally associated with both plugs of the cord circuit, a second supervisory relay, and a key, actuation of said key causing disassociation of the operator's telephone apparatus from one plug of the cord circuit and disconnection from the cord circuit of the first supervisory relay, said key upon actuation causing also said second supervisory relay to be substituted for the disconnected supervisory relay.

28. In a telephone exchange system, the combination with a cord circuit for connecting telephone lines together, a supervisory relay normally connected with the cord circuit, a second supervisory relay normally disconnected from the cord circuit, and means adapted upon actuation to disconnect the first supervisory relay from the cord circuit and to substitute therefor the second supervisory relay.

29. In a telephone exchange system, the combination with a cord circuit terminating in plugs engaging with springjacks connected with telephone lines, said cord circuit being divided into two conductively distinct sections, operator's telephonic apparatus nor-

mally connected with both sections, a supervisory relay common to both sections, a key, and a second supervisory relay normally disconnected from the cord circuit, actuation of said key in one direction causing disconnection of the operator's telephonic apparatus and said first supervisory relay from the corresponding cord section and connection of said second supervisory relay with said section.

30. In a telephone exchange system, the combination with a trunk circuit for connecting with telephone lines, of a cord circuit for connecting other telephone lines with said trunk circuit, a supervisory relay connected with the cord circuit, connection of said cord circuit with the trunk circuit causing closure of a circuit through said supervisory relay, a controlling relay associated with the trunk circuit, and apparatus at the substation connected with the trunk circuit adapted upon actuation to close a circuit through the controlling relay whereby said relay is operated to open the supervisory relay circuit.

31. In a telephone exchange system, the combination with a trunk circuit for connecting with telephone lines, of a cord circuit for connecting other telephone lines with said trunk circuit, a controlling relay at the trunk circuit included in circuit with the line and substation connected with the trunk line, a supervisory relay associated with the cord circuit, connection of the cord circuit with the trunk line causing closure of a circuit including said supervisory relay and contacts of said controlling relay, actuation of apparatus at the substation connected with the trunk line causing actuation of the controlling relay to open the supervisory relay circuit.

32. In a telephone exchange system, the combination with a trunk circuit for connecting with telephone lines, of a cord circuit for connecting other telephone lines with said trunk circuit, a controlling relay at the trunk circuit, a supervisory relay connected in bridge of the cord circuit, connection of said cord circuit with the trunk circuit causing closure of an energizing circuit through said supervisory relay and through contacts of said controlling relay, said controlling relay being under control of apparatus at the substation connected with the trunk line.

33. In a telephone exchange system, the combination with a trunk circuit for connecting telephone lines leading to substations, of a cord circuit for connecting other telephone lines with said trunk circuit, a controlling relay of the trunk circuit controlled by substation apparatus after connection of the trunk circuit with the line, a supervisory relay for the trunk circuit, a supervisory relay for the cord circuit, connection of said cord circuit with the trunk circuit causing

closure of an energizing circuit through said supervisory relays, said controlling relay upon response to substation apparatus being adapted to disconnect the cord circuit supervisory relay and to maintain the circuit through the trunk circuit supervisory relay.

In witness whereof, I hereunto subscribe

my name this 22nd day of January A. D. 1906.

MERRITT S. CONNER.

Witnesses:

CHARLES J. SCHMIDT,

LEONARD W. NOVANDER.