

Oct. 13, 1925.

H. D. CURRIER ET AL.

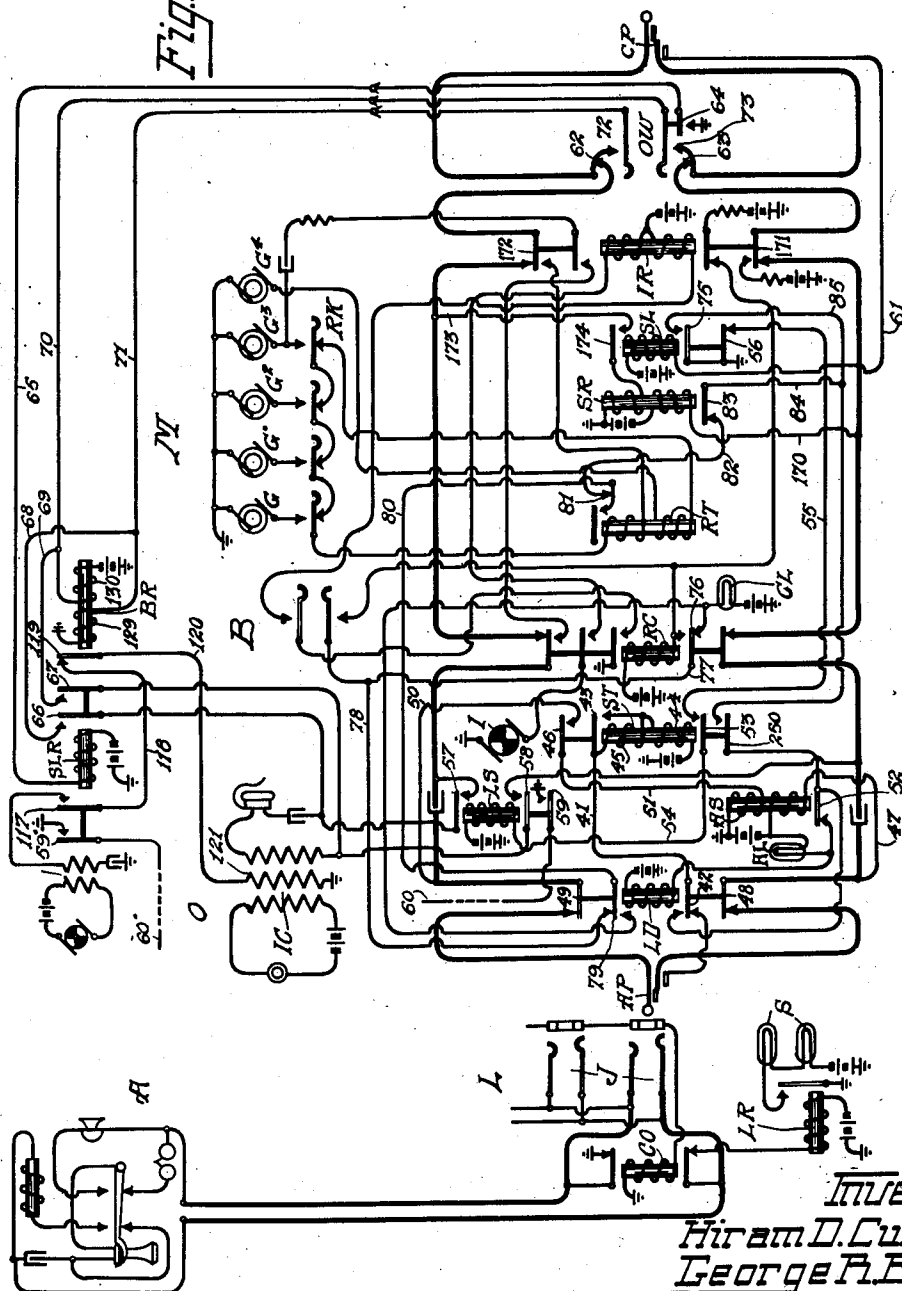
1,556,761

TRUNK CIRCUITS

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3 Sheets-Sheet 1

Fig. 1 Part I.



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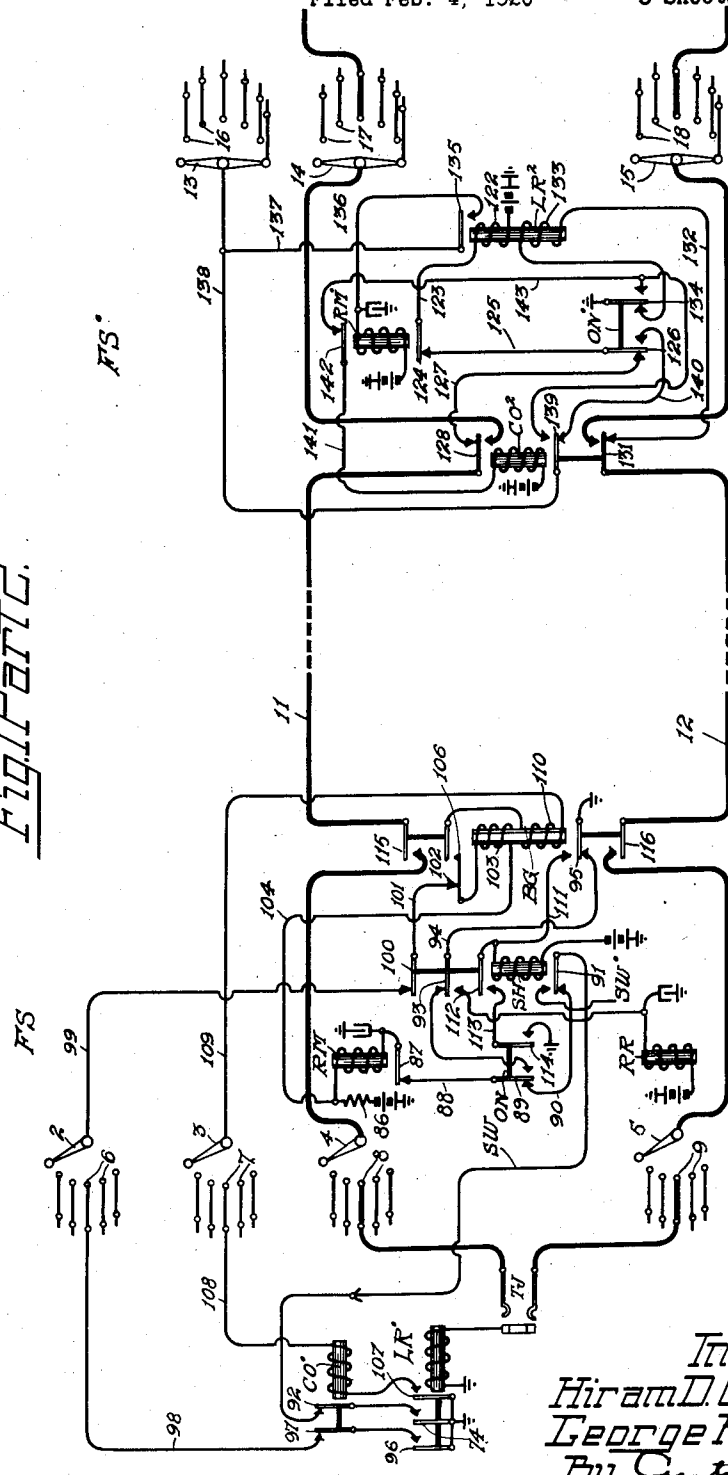
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3 Sheets-Sheet 2

Fig. 1 Part 2.



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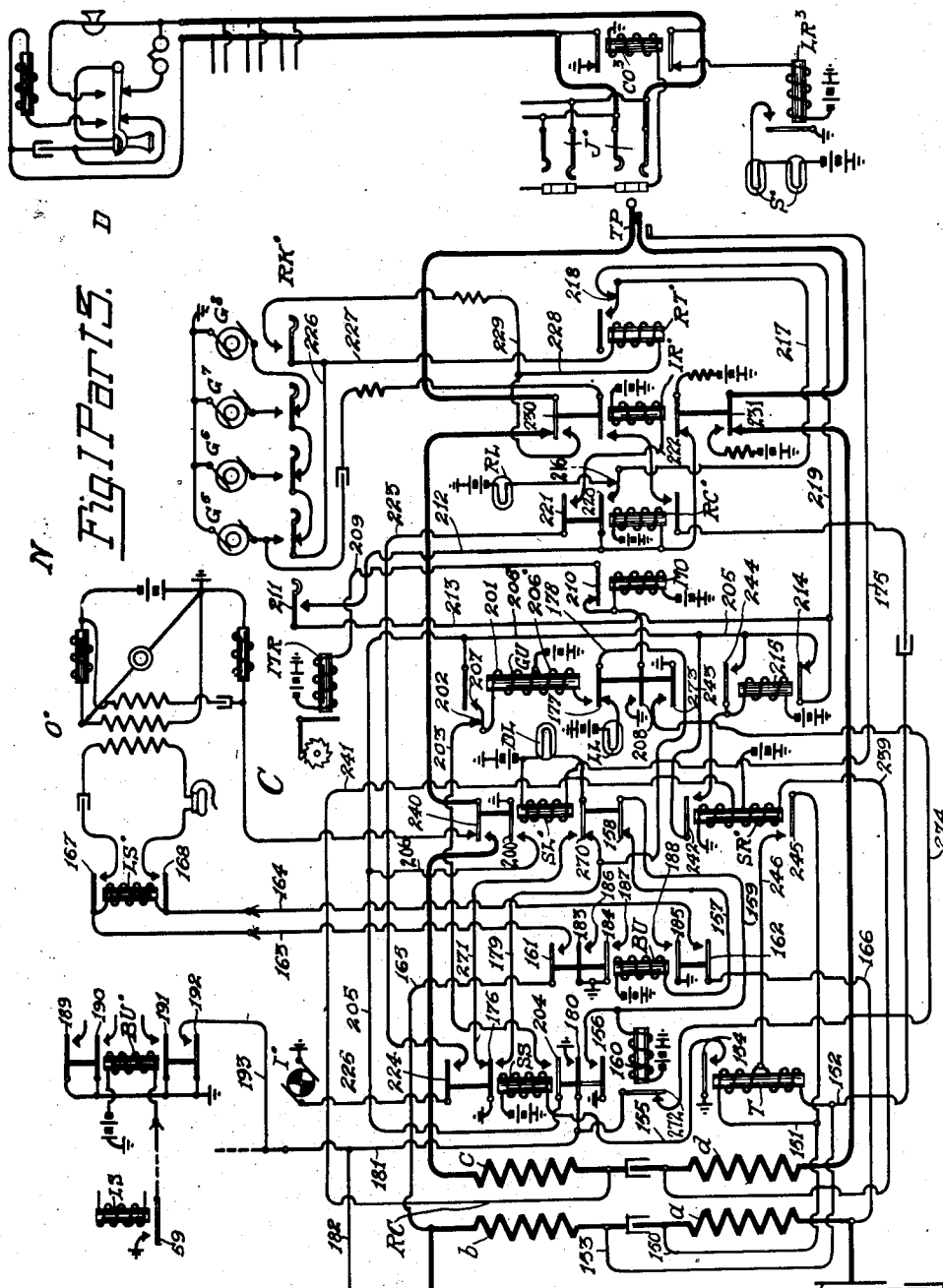
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3 Sheets-Sheet 3



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Patented Oct. 13, 1925.

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UNITED STATES PATENT OFFICE.

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TRUNK CIRCUITS.

Application filed February 4, 1920. Serial No. 356,262.

To all whom it may concern:

Be it known that we, HIRAM D. CURRIER and GEORGE R. EATON, citizens of the United States, and residing at Chicago and Oak Park, respectively, county of Cook and State of Illinois, have invented certain new and useful Improvements in Trunk Circuits, of which the following is a specification.

Our invention relates to telephone systems and has to do more particularly with multi-office exchange systems in which the subscribers' stations of the same exchange or different exchanges are connected by means of manual switchboard apparatus and automatic apparatus, and one of the main objects of our invention is to provide improved circuit arrangements for a system of the above character, and in which we eliminate the special B or trunking operators.

In most multi-office exchange telephone systems of the above type, that is, wherein operators are provided for manipulating the cord and trunk circuits, the operators use cord circuits for interconnecting the lines of their own exchange, but when they desire to connect with a line in a distant exchange, they connect to a trunk circuit terminating before a B or special trunking operator in the distant exchange. The B operator connects the trunk circuit to the wanted line after having communicated with the A operator at the originating exchange over a special order wire independent of the trunk circuits. In the larger exchange systems even the calls local to an exchange are trunked to a B operator, who completes the connection.

Systems of this character have been found faulty, due to the fact that special trunking positions and trunking operators are required to handle these trunking connections, and to overcome these objections we provide circuits in which the A operator, in addition to the usual answering and multiple jacks for establishing local connections, is provided with trunk jacks which are accessible from her position and which are connected to apparatus that extends to different exchanges and terminates in plugs before A operators at such exchanges so that each operator has both outgoing and incoming trunks.

One of the features of our invention is the termination of the outgoing trunk jacks in the banks of finder switch structures, so

that when a connection is established with an outgoing trunk jack for extending a connection to a distant exchange, one of the plurality of finder switches is caused to operate to seize the trunk jack.

Another feature of our invention is the termination of the incoming ends of the trunk circuits at the distant exchanges in individual non-numerical trunk selecting switches, which trunk selecting switches are adapted to extend the connections to idle trunks leading to idle operators at the distant exchanges.

A further feature of our invention is the provision of means for automatically busy-ing all of the trunks terminating at an operator's position during the time that she is establishing a connection.

These features, as well as others, will be more fully pointed out in the following description and appended claims.

For a more complete understanding of our invention reference may be had to the accompanying drawings, in which we illustrate apparatus for interconnecting two subscribers at different exchanges and which comprises Fig. 1, parts 1, 2 and 3, which, when joined, illustrate a complete connection. All the parts have been shown at normal and the apparatus shown in part 1 and the left half of part 2 is located at one exchange, and the right half of part 2 and all of part 3 in another exchange.

Referring now more in general to the preferred form of our invention, it comprises exchanges M and N. At the exchange M, a plurality of substations A are provided, terminating in line circuits L comprising the usual cut-off relay CO, line relay LR, multiple line lamps S and multiple jacks J. The multiple jacks J terminate before a number of different operators' positions, each of which is provided with a line signal S so that when a call is initiated a plurality of signals S are lighted, and thus a number of operators are apprised of the call. For interconnecting the substations a plurality of cord circuits B are provided at each of the operators' positions, each cord including answering and calling plugs AP and CP connected by the heavily marked conductors with interposed condensers. The answering end of the cord circuit B is provided with a sleeve relay ST which is energized when an

answering plug AP is inserted into the jack J of a calling line. The relay ST is provided with a high and low resistance winding, and upon the actuation of relay ST the high resistance winding is shunted and thus prevents a relay ST of another cord circuit, as B, from being energized, should the operator associated with the second cord attempt to answer the call. An operator of another cord attempting to seize the call after the first operator has connected to the calling line is prevented from communicating with the subscriber as the low winding of relay ST of the first cord prevents the relay ST of the second cord from operating. As the second operator is not connected to the calling line, due to the relay ST of the second cord remaining normal, she does not receive an answer from the calling subscriber and withdraws the answering plug of her cord circuit from the connected jack.

An answering supervisory relay AS is also provided and is actuated upon the energization of relay ST. The said relay AS upon actuation prevents the premature lighting of the answering supervisory lamp AL. A listening relay LS is also provided and is actuated in response to the energization of relay ST to connect the operator's set O to the cord conductors. A link disconnect relay LD is provided which is energized when the calling subscriber replaces his receiver after finishing conversation, to open the link conductors to allow the line circuit L of the calling subscriber to restore to normal to permit the subscriber to recall. The relay LD also operates when the calling subscriber replaces his receiver and before the called subscriber answers to disconnect the ringing current from the called line when the cord circuit B is used for establishing a local connection.

The calling end of the cord circuit is provided with a sleeve relay SL actuated when the calling plug CP is inserted into a jack of the called local line or into an outgoing trunk jack which extends to a distant exchange. The relay SL, upon energization, opens the circuit of the listening relay LS, which relay deenergizes to disconnect the operator's set O from the cord conductors. A party line ringing key RK is provided for connecting one of a plurality of ringing generators G, G', G², G³ and G⁴ to signal called subscribers when the cord circuit is used to establish a local connection. A ringing control relay RC is provided which is actuated upon the actuation of the ringing key RK and the said relay RC upon actuation brings about the energization of the interrupter relay IR. The relay IR is intermittently energized and deenergized through the agency of the interrupter I to connect ringing current to the called local line. A ringing trip relay RT is provided

which is actuated upon the response of the subscriber at the local called for substitution. A supervisory relay SR is also provided which is actuated upon the response of the called for subscriber, either by the response of a locally connected subscriber or a subscriber at a distant exchange. A calling supervisory lamp CL is provided and is used for the usual supervisory purposes.

In order to handle trunking connections in addition to the equipment just described, a trunk order wire key OW is provided for each cord circuit, which key when actuated operates a secondary listening relay SLR which connects the operator's set O, and also opens the cord conductors. The operator's set O is connected to the calling end of the cord circuit B, whereby the operator at the said cord circuit B may converse with the operator to whom the trunk connection is to be extended.

The secondary listening relay SLR, the battery feed and tone disconnect relay BR and tone device ST are common to an operator's position and are brought into association with a trunking connection when the order wire key OW is actuated, as will be more fully hereinafter described.

Referring now to part 2, we here show a trunk jack TJ of which there are a number, before each operator's position, and which are multiply connected to a plurality of finder switches FS whereby any one of a plurality of the said switches FS may seize the connected trunk jack TJ, as will be more fully hereinafter described. Associated with each trunk jack TJ we show a line relay LR' and a cut-off relay CO', for purposes as will be more fully hereinafter described. The finder switch FS may be of any desired or suitable construction and is provided with a spring-restored shaft having wipers 2, 3, 4 and 5, and with four sets of fifty contacts 6, 7, 8 and 9, to which contacts the trunk jacks TJ are multiplied.

A rotary step-by-step magnet RM is provided for rotating the switch shaft and wipers 2, 3, 4 and 5 by means of a ratchet and pawl mechanism. A retaining pawl is also provided and adapted to be operated by a release relay RR for permitting the shaft wipers 2, 3, 4 and 5 to be restored to normal by spring tension. A common starting wire SW is provided and is common to a group of trunk jacks TJ which lead to a group of switches. A bridging relay BG is provided which energizes when the trunk jack TJ is seized by the switch to shunt the rotary magnet RM to prevent further advancement of the wipers 2, 3, 4 and 5. The switching relay SH energizes upon the actuation of relay BG to extend the starting conductor SW through to the next finder switch FS (not shown). The switch FS is also provided

with a set of off-normal contacts ON which assume their alternate position upon the first step of the switch off-normal and remain so until the switch is again restored to normal.

For a more complete description of the switch FS, reference may be had to our co-pending application filed February 24th, 1919, and bearing Serial No. 278,745.

The trunking circuit extends to the distant exchange via the conductors 11 and 12, which conductors terminate in a trunking switch FS' located at the said distant exchange N. The switch structure of FS' is of an approved type of switch, known as a switch of the non-restoring type, whose wipers remain in contact with the last trunk used, and will again seize the trunk last used, provided the trunk in the meantime has not been seized for extending a connection. The switch FS' is provided with a line relay LR², which relay LR² actuates when the switch FS seizes the outgoing trunk jack TJ. A set of off-normal contacts ON' are provided which assume their alternate positions upon the energization of the line relay LR². A rotary step-by-step magnet RM' is provided which steps the wipers 13, 14, 15 to the next set of contacts 16, 17 and 18, in case the contacts last engaged by the wipers 13, 14 and 15 are busy, and continues to do so until an idle set of contacts 16, 17 and 18 are encountered leading to an idle operator. A cut-off relay CO² is provided which is energized when an idle operator is seized and the energization of relay CO² restores the off-normal contacts ON'. The off-normal springs are so arranged that when the line relay LR² energizes a catch mechanism is operated to release the off-normal springs ON' to their operated position, and upon the energization of the cut-off relay CO² the springs are restored to their normal position, in which position the catch mechanism is brought into operation to hold the off-normal contacts ON' in their normal position. For a more detailed description of the switch structure, reference may be had to application filed January 20th, 1919, and bearing Serial No. 271,960.

The incoming trunk circuit C, as illustrated in Part 3, is adapted to be seized by the switch FS' and terminates at its incoming end in a repeating coil RC, comprising windings *a*, *b*, *c* and *d*. A high resistance test relay T is provided which is actuated when the trunk is seized and a relay SS is provided, which relay energizes upon the energization of the relay T. A busy relay BU is provided which is energized upon the energization of relay SS, the said relay BU busying all the other trunks terminating at an operator's position while she is establishing a trunk connection, as will be more fully hereinafter described. A listening relay

LS' common to the operator's position is energized upon the energization of relay BU to connect the operator's set O' to the trunk conductors. A line lamp LL is provided which is lighted when relay SS operates to inform the operator that a call is awaiting her attention. A sleeve relay SL' is provided which is energized when the trunk plug TP of the trunk circuit C is inserted in the jack of the called line, and a busy guarding relay GU is also provided, which relay GU is energized upon the energization of the relay SL'. A meter magnet MR is also provided which is energized upon the actuation of relay SL' to register a connection, and a meter cut-off relay MO is provided which is energized after the meter registers to prevent further registrations of the meter. A party line ringing key RK' is provided, and associated therewith are a plurality of ringing generators G⁵, G⁶, G⁷ and G⁸ for the usual signaling purposes. A ringing control relay RC', a ringing interrupter relay IR' and a ringing trip relay RT' are provided for controlling the application of ringing current, as will be more fully hereinafter described. A calling supervisory relay SR' is also provided which is energized when the called subscriber answers. A busy relay BU' is provided which is common to an operator's position and is energized when the operator associated with the trunk circuit C is establishing a local connection to busy her associated trunk jacks. The listening relay LS of her cord circuit is energized to close the circuit of the busy relay BU', which latter relay busies the trunks terminating before her position while establishing a local connection.

To the right of the drawing, we show a called substation D similar to the substation A, the said substation D terminating at the exchange in a line relay LR³, cut-off relay CO³, multiple line lamps S' and multiple jack J'.

Having described in general the apparatus used in establishing a connection between a calling subscriber at one exchange and a called subscriber at another, we will now describe in detail the operation of the apparatus in completing a call from the subscriber at substation A of exchange M to the subscriber at substation D at exchange N.

Assuming now that the subscriber at the calling substation A in the exchange M initiates a call, the removal of the receiver thereat closes an energizing circuit for the line relay LR of the line circuit L, over the line conductors and the closing of the alternate contact of line relay LR lights line lamps S at a plurality of operators' positions. Assuming that it is the operator associated with the cord circuit B that answers

the call, the insertion of the plug AP into the jack J of the calling line establishes a series energizing circuit for the cut-off relay CO of the line circuit L and the sleeve relay ST of cord circuit B over a circuit traced from battery through the windings 44 and 45 of the relay ST, conductor 41, closed contact 42 of disconnect relay LD, the sleeve contacts of the connected plug AP and jack J and through the winding of the cut-off relay CO to ground. The closure of alternate contact 43 of relay ST closes a low resistance circuit through the low resistance winding 44 of relay ST, the circuit being traced from battery through the winding 44 of relay ST, its alternate contact 43, over the previously traced path to ground at cut-off relay CO. The high resistance winding 45 of relay ST is shunted, this arrangement providing for secret service, as relay ST of a second cord will not operate in series with the relay CO for the reason that the low winding of the relay ST of the cord circuit B renders the relay ST of the second cord inoperative. The closing of alternate contact 46 of relay ST establishes an energizing circuit for the answering supervisory relay AS traced from battery through the lower winding of the relay AS, conductor 47, normal contact 48 of relay LD, ring contacts of the connected plug AP and jack J, through the now closed contacts of the substation switchhook, back through the tip contacts of the jack J and plug AP, contact 49 of relay LD, conductor 50, through alternate contact 46 of relay ST, conductor 51 and through the upper winding of relay AS to ground.

The opening of normal contact 52 of relay AS, upon its energization, prevents the premature lighting of the answering supervisory lamp AL. The energization of the relay CO of the line circuit L opens the energizing circuit of the line relay LR, which relay restores to efface the line signals S. The closing of alternate contact 53 of relay ST establishes an energizing circuit for the listening relay LS, the circuit being traced from battery through the winding of the relay LS, conductor 54, through alternate contact 53 of relay ST and conductor 55 to ground at normal contact 56 of the sleeve relay SL. The relay LS, upon energizing, closes its alternate contacts 57 and 58 to connect the operator's set O to the cord conductors. Should another operator attempt to seize the call after the operator associated with the cord circuit B is connected thereto, the low resistance path through winding 44 of the relay ST prevents the relay ST of the second cord from operating, and the listening relay LS of the second cord failing to operate does not connect its associated operator's set O across the cord conductors. The second operator failing to receive a response when she answers, knows

that the call has been answered by another operator and withdraws the plug of her cord circuit from the multiple jack of the calling line.

The closing of alternate contact 59 of relay LS places a ground upon the conductor 60, which conductor leads to a busy relay common to a group of trunks which also terminate before the operator, the said relay actuating to place ground upon the trunks associated with her position, busying them and preventing any of them being seized while she is establishing a local connection, as will be more clearly hereinafter described. The relay LS, upon energization, closes its alternate contacts 57 and 58, connecting the operator's set O to the cord conductors and the operator now inquires the wants of the calling subscriber at the substation A. The cord circuit B may be used for establishing local connections between the subscribers terminating at the exchange M and also may be used for trunk connections between it and distant exchanges.

Assuming that the subscriber at the substation terminating at exchange M wishes to converse with a subscriber at the substation D terminating at the exchange N, the operator now inserts the calling plug CP into a trunk jack TJ which leads to the exchange N, and after the insertion of the plug CP into the trunk jack TJ, the operator actuates the trunk order wire key OW, which order wire key OW is individual to the cord circuit. The insertion of the plug CP into the trunk jack TJ establishes a series energizing circuit for the sleeve relay SL of the cord circuit B, and the line relay LR' associated with the trunk jack TJ, the circuit being traced from battery through the winding of the sleeve relay SL, conductor 61, sleeve contacts of the connected plug CP and trunk jack TJ through the winding of the relay LR' to ground. Relay SL now energizes and opens its normal contact 56, thus opening the energizing circuit of the listening relay LS, which relay LS restores to normal, and the opening of alternate contact 57 and 58 disconnects the operator's set O from the cord conductors. The closing of alternate contact 75 of relay SL closes a circuit for the calling supervisory lamp CL, traced from battery through the said lamp CL, normal contact 76 of relay RC, conductors 77 and 78, normal contact 79 of link disconnect relay LD, conductor 80, normal contact 81 of ringing trip relay RT, conductor 82, normal contact 83 of supervisory relay SR, conductors 84 and 85 to ground at alternate contact 75 of relay SL, said lamp CL now lighting.

The actuation of trunk order wire key OW opens the cord conductors at the calling end of the cord circuit B at its contacts 62 and 63, and the closing of alternate con-

tact 64 of the order wire key OW establishes an energizing circuit for the secondary listening relay SLR over a circuit traced from battery through the winding of said relay
 5 SLR, conductor 65 to ground at alternate contact 64 of the key OW. The relay SLR, it is to be understood, is common to an operator's position, and the closure of its alternate contacts 66 and 67 connects the opera-
 10 tor's set O to the calling end of the cord, over conductors 68 and 69, 70 and 71 and through make-before-break contact 72 and 73 of the key OW to the tip and sleeve conductors of the cord circuits B. The closure
 15 of alternate contact 74 of the line relay LR' which is associated with the jack TJ establishes an energizing circuit for the rotary magnet RM of the finder switch FS, associated with the trunk jack TJ, into which
 20 the calling plug CP has been inserted. The circuit of the rotary magnet RM may be traced from battery through the resistance 86, through the winding of the rotary magnet RM, its normal contact 87, conductor
 25 88, normal contact 89, of the off-normal contact ON, conductor 90, normal contact 91 of the switching relay SH, the starting conductor SW, which conductor SW is common to a group of trunk jacks TJ terminating
 30 before an operator's position, normal contact 92 of the cut-off relay CO' to ground at alternate contact 74 of the line relay LR'. Motor magnet RM upon energization steps the wipers 2, 3, 4 and 5 of the finder switch
 35 FS into engagement with the first set of contacts 6, 7, 8 and 9, and upon the first step of the wipers 2, 3, 4 and 5 from their normal position, the off-normal contacts ON assume their alternate position, and the
 40 opening of normal contact 89 opens the initial energizing circuit of the rotary magnet RM, but a substitute energizing circuit is again established for the rotary magnet RM upon the closure of its normal contact
 45 87, the circuit being traced from battery through the resistance 86, through the winding of rotary magnet RM, its normal contact 87, alternate contact 89 of off-normal contacts ON, normal contact 93 of the switching
 50 relay SH, conductor 94 to ground at normal contact 95 of the bridging relay BG. The magnet RM, upon energization, steps the wipers 2, 3, 4 and 5 into engagement with the next set of contacts 6, 7, 8 and 9, and
 55 the opening of its normal contact 87 allows the magnet RM to restore. Upon the closure of contact 87 magnet RM is again energized, and the interruption of its contact 87 causes the said magnet RM to energize and deenergize, stepping the wipers 2,
 60 3, 4 and 5 over the contact sets 6, 7, 8 and 9, in search of the elected trunk jack TJ, and when wiper 2 of the switch FS engages the grounded contact 6 associated with the
 65 trunk jack TJ of the elected trunk, a circuit

is established for relay BG, traced from ground at alternate contact 96 of the line relay LR', normal contact 97 of cut-off relay CO', conductor 98, contact 6, wiper 2, conductor 99, normal contact 100 of switching
 70 relay SH, conductor 101, normal contact 102 of relay BG, the upper winding 103 of the relay BG, conductor 104 and through the resistance 86 to battery and ground. The low resistance path through the winding 103 of
 75 relay BG shunts the magnet RM, preventing further actuation of the said magnet RM, and the closing of make-before-break contact 106 of the relay BG closes a locking circuit for the relay BG, traced from ground
 80 at alternate contact 107 of the line relay LR', through the winding of the cut-off relay CO', conductor 108, contact 7, wiper 3, conductor 109, through the lower winding
 85 110 of relay BG, alternate contact 106 of relay BG, through the upper winding 103 of the said relay, conductor 104 and resistance 86 to battery and ground. The closing of alternate contact 95 of relay BG establishes
 90 an energizing circuit for the switching relay SH, traced from battery through the winding of the said relay SH, conductor 111, to ground at alternate contact 95 of relay BG.

The closing of alternate contact 112 of
 95 relay SH establishes a locking circuit for the said relay SH, traced from battery through the winding of the relay SH, its alternate contact 112, conductor 113, to
 100 to ground at alternate contact 114 of off-normal contacts ON. The closing of alternate contact 91 of relay SH now extends the common starting wire SW through the said
 alternate contact 91 to the starting wire SW', which wire SW' leads to the next switch of
 105 the group so that in the event an operator inserts another plug CP into a trunk jack TJ associated with her position, the next switch of the group will be used to select the
 110 trunk jack. The closing of alternate contact 117 of the secondary listening relay SLR connects the special tone ST to the tertiary winding 121 of the operator's set O, the tone being traced from the special
 115 tone apparatus ST to alternate contact 117 of relay SLR conductor 118, normal contact 119 of relay BR, conductor 120, through the winding 121 of the operator's induction coil
 120 IC to ground. The operator of the cord circuit B extending the trunk connection receives a tone notifying her that the switch FS is operating to select the elected trunk.
 Closure of contact 59' connects ground over conductor 60' to the busy relay. The switch
 125 FS having selected trunk jack TJ to be used in extending the connection to the distant exchange N, wipers 2, 3, 4 and 5 engage the contacts 6, 7, 8 and 9 associated with the trunk jack TJ and the energization of relay
 BG closes its alternate contacts 115 and 116 130

to close the continuity of the trunk conductors 11 and 12, which now extends the connection to the incoming end at the distant exchange. The trunk selected terminates at the distant exchange N in a switch FS', and upon the closure of the alternate contacts 115 and 116 of the relay BG of the switch FS, an energizing circuit is established for the combined battery feed and tone disconnect relay BR associated with the cord circuit B at the originating exchange M and for the line relay LR² of the switch FS' at the incoming end of the trunk at the exchange N.

The circuit of the relays BR and LR² may be traced from battery through the upper winding 122 of line relay LR², conductor 123, normal contact 124 of the rotary magnet RM', conductor 125, normal contact 126 of the off-normal contacts ON', conductor 127, normal contact 128 of the cut-off relay CO², conductor 11, alternate contact 115 of the relay BG, wiper 4, the contact 8, tip contacts of the connected plug and jack CP and TJ, make-before-break contact 72 of the order wire key OW, conductor 71, to ground through the winding 129 of the relay BR. A second circuit is also established for the said relays and may be traced from battery through the winding 130 of the relay BR, conductor 70, alternate contact 73 of the order wire key OW, ring contacts to the connected plug CP and trunk jack TJ, contact 9, wiper 5, alternate contact 116 of the relay BG, trunk conductor 12, normal contact 131 of relay CO², conductor 132, through the winding 133 of the line relay LR² to ground at normal contact 134 of the off-normal contacts ON'. The relay BR, upon energization, opens its normal contact 119, disconnecting the tone ST from the operator's set O of the cord circuit B, notifying her that the trunk jack TJ has been selected, and that the call has been extended to the distant exchange N.

The switch FS', as already stated, is of the non-restoring type, and should the wipers 13, 14, 15 be resting on an idle set of contacts 16, 17 and 18 leading to an idle operator at the distant exchange, the switch FS' remains in engagement with the said contacts last used without any actuation of the switch. Should the contact 16, which we may term a test contact be grounded, due to the operator with which the trunk C is associated being busy in establishing a local connection or a trunk connection, the contacts 16 will have a busy or ground potential thereon. The line relay LR², upon energization, holds the off-normal contacts ON' in their alternate position and, assuming that the operator associated with the trunk C is busy, upon the closure of alternate contact 135 of the relay LR², an energizing circuit for the rotary magnet RM' is established, traced from battery through the winding of the said magnet RM', conductor 136, alternate contact 135 of relay LR², conductors 137 and 138, wiper 13 to the engaged grounded contact 16. The line relay LR² has its circuit opened when off-normal contacts ON' assume their alternate position, at which time normal contact 126 moves to its alternate position, but a substitute circuit is established for it, which may be traced from the grounded busy contact 16, wiper 13, conductor 138, normal contact 139 of cut-off relay CO², conductor 140, alternate contact 126 of the off-normal contacts ON', normal contact 124 of relay RM', conductor 123 to battery and ground through the winding 122 of relay LR². Magnet RM', upon energization, opens its normal contact 124, interrupting the circuit of the line relay LR² just traced, and the said relay LR² restores, opening the circuit of the rotary magnet RM' at alternate contact 135. The line relay LR² and rotary magnet RM' are thus alternately energized and de-energized, and the rotary magnet RM' steps the wipers 13, 14 and 15 from one contact set 16, 17 and 18 to the next until the idle contact 16 leading to an idle operator is encountered, and as this idle contact 16 is free from ground, relay LR² and magnet RM' remain at normal, preventing further movement of the switch wipers 13, 14 and 15. When an idle set of contacts are encountered, a circuit for cut-off relay CO² of the trunk switch FS' is established, traced from battery through the winding of the cut-off relay CO², conductor 141, normal contact 142 of rotary magnet RM', conductor 143 to ground at alternate contact 134 of off-normal contacts ON'. The relay CO², upon energization, restores the off-normal contacts ON' to their normal position and the opening of alternate contact 134 interrupts the initial energizing circuit for the cut-off relay CO², but a substitute circuit is established for the said relay CO², as will presently be described. The contacts 128 and 131 of relay CO², upon energization, assume their alternate positions and open the circuit of relay LR². If the wiper 13 of switch FS' is engaging an idle contact 16 free from ground when the call is extended to switch FS', no circuit is established for rotary magnet RM' and a circuit is immediately established for cut-off relay CO², which relay upon energization opens the circuit for relay LR² at its contacts 128 and 131 and brings about the restoration of the off-normal contacts ON'. The wipers 13, 14 and 15 having engaged a set of contacts 16, 17 and 18 leading to an idle trunk circuit C and the closure of alternate contacts 128 and 131 of the cut-off relay CO² extends the trunk conductors to the selected idle trunk circuit C. An energizing circuit for the high resistance test relay T

of the trunk circuit C is now established, traced from battery through the winding 130 of the relay BR associated with cord B at exchange M, conductor 70, alternate contact 73 of the order wire key OW, ring contacts of the connected plug CP and trunk jack TJ, contact 9, wiper 5, alternate contact 116 of relay BG, trunk conductor 12, alternate contact 131 of relay CO², wiper 15, contact 18, winding "a" of the repeating coil RC, conductors 150 and 151, through the winding of the relay T, conductors 152 and 153, the winding "b" of the repeating coil RC, contact 17, wiper 14 of trunk switch FS', alternate contact 128 of the relay CO², trunk conductor 11, alternate contact 115 of the relay BG, wiper 4, contact 8, tip contact of the connected plug CP and trunk jack TJ, alternate contact 72 of the order wire key OW, conductor 71 to ground through winding 129 of the relay BR. The closing of alternate contact 154 of the relay T establishes an energizing circuit for the secondary relay SS, traced from battery through the winding of the relay SS, conductor 155 to ground at alternate contact 154 of relay T. The closing of alternate contact 156 of relay SS establishes an energizing circuit for the busy relay BU, traced from battery through the winding of the relay BU, conductor 157, normal contact 158 of the sleeve relay SL', conductor 159 to ground at alternate contact 156 of relay SS. The closure of alternate contact 180 of the relay SS places a ground upon the test contacts 16 of the trunk switches FS', with which the trunk C is multiply associated, preventing any other trunk switch from selecting this particular trunk circuit C that is now in use in extending the connection to the subscriber at substation D. This ground also closes a locking circuit for the cut-off relay CO² of the trunk switch FS', traced from ground at alternate contact 180 of relay SS, conductors 181 and 182, contact 16, wiper 13, conductor 138, alternate contact 139 of relay CO², conductor 143, normal contact 142 of relay RM', conductor 141, through the winding of relay CO² to battery and ground. The closure of alternate contacts 183, 184 and 185 of busy relay BU places a ground on the conductors 186, 187 and 188, which lead to the other trunks which terminate at her position, placing a busy potential upon the test contacts 16 of the trunk switches to which the trunks are multiplied, preventing said trunks from being selected during the time that she is extending the connection to the called subscriber at the substation D. We also show a busy relay BU', which relay is common to an operator's position and is energized when the operator is establishing a local connection. When a cord circuit as B is used, the listening relay LS of the cord

closes its alternate contact 59, which establishes an energizing circuit for the busy relay BU' from ground at alternate contact 59 of the listening relay LS of the cord circuit that is used in establishing a local connection to battery and ground through the winding of relay BU'. The closure of alternate contacts 189, 190, 191 and 192 connects ground to the trunk circuits terminating at this operator's position, the ground extending to the test contacts 16 of the trunk switches FS' to which the trunks are multiplied, preventing the said switches from seizing any trunk terminating at this operator's position while she is establishing a local connection. A circuit for the relay 160 is also established upon the closure of alternate contact 156, traced from battery through the winding of the said relay 160 to ground at alternate contact 156 of relay SS, for purposes as will be more fully hereinafter described. The closure of alternate contacts 161 and 162 of the relay BU establishes an energizing circuit for the listening relay LS', over the conductors 163 and 164 through alternate contacts 161 and 162 of the relay BU, over conductors 165, 166 to battery and ground over the previously described path, including windings 129 and 130 of the relay BR. The closure of alternate contacts 167 and 168 of the listening relay LS' connects the operator's set O' to the trunk conductors, placing the operator of the trunk circuit C in communication with the operator of the cord circuit B at the exchange M. The closure of alternate contact 176 of relay SS establishes a circuit for the line lamp LL from battery through the said lamp LL, normal contact 177 of relay GU, conductors 178 and 179 to ground at alternate contact 176. The lamp LL lighting notifies the operator associated with the trunk C that a call has been extended to her position. The operator of the trunk C now being connected to the seized trunk C, inquires the number of the operator at the exchange M, and assuming that it is the subscriber D in the exchange N that is wanted, she tests the line as to its idle or busy condition in the usual manner. After the operator at the exchange M has repeated the number of the called subscriber to the operator at the exchange N, she restores the order wire key OW to its normal position, and the opening of alternate contact 64 of the order wire key OW opens the circuit of the secondary listening relay SLR, which relay, upon restoration, opens its alternate contacts 66 and 67 to disconnect the operator's set O. The closure of make-before-break contacts 62 and 63 of the order wire key OW establishes a substitute circuit for the high resistance test relay T over a circuit traced from battery through the lower winding of the relay SR, conductor 170, nor-

mal contact 171 of the ringing interrupter relay IR, normal contact 63 of order wire key OW, contacts of the connected plug CP and trunk jack TJ, contact 9, wiper 5, alternate contact 116 of relay BG, trunk conductor 12, alternate contact 131 of relay CO², wiper 15, contact 18, winding "a" of the repeating coil RC, conductors 150 and 151, through the winding of the relay T, conductors 152 and 153, winding "b" of the repeating coil RC, contact 17, wiper 14, alternate contact 128 of relay CO², trunk conductor 11, alternate contact 115 of relay BG, wiper 4, contact 8, tip contacts of the connected trunk jack TJ and plug CP, normal contact 62 of the order wire key OW, normal contact 172 of the ring interrupter relay IR of the cord circuit B, conductor 173, alternate contact 174 of the sleeve relay SL to ground, through the upper winding of the supervisory relay SR. The high resistance test relay T prevents the energization of the supervisory relay SR, and the calling supervisory lamp CL of the cord circuit B at the exchange M remains lighted until the called subscriber D at the distant exchange N answers in response to his call signal. The operator of the trunk circuit C tests the line of the call subscriber B as to its idle or busy condition in the usual manner by placing the tip of the trunk plug TP to the sleeve of the jack J' of the called line, and if the said line is busy, the operator receives the customary click in her head receiver, notifying her of the busy condition of the called subscriber at the substation D. Assuming that the line is idle, the operator inserts the trunk plug TP into the jack J' of the called line, and the insertion of the said plug TP establishes a series energizing circuit for the sleeve relay SL' and the cut-off relay CO³ of the line circuit L', the circuit being traced from battery through the winding of the sleeve relay SL', conductor 175, sleeve contacts of the connected plug TP and jack J' to ground through the winding of the cut-off relay CO³.

The sleeve relay SL' upon energization closes its alternate contact 200, establishing an energizing circuit for the busy guard relay GU, traced from battery through the winding 201 of the said relay GU, normal contact 202 of relay GU, conductor 203, alternate contact 204 of relay SS, conductors 205 and 206 to ground at alternate contact 200 of the sleeve relay SL'. A locking circuit is closed through the lower winding 206' of the relay GU upon the energizing of the said relay GU, the locking circuit being traced from battery through the lower winding 206 of relay GU, alternate contact 177 of relay GU, conductors 178 and 179 to ground at alternate contact 146 of the relay SS. A locking circuit is also established through the upper

winding 201 of the relay GU, traced from battery through the upper winding 201, alternate contact 207 of relay GU, conductors 205 and 206 to ground at alternate contact 200 of relay SL', and these two locking circuits for the relay GU as just traced are for purposes as will be presently described. The opening of normal contact 177 of relay GU opens the circuit of the line lamp LL, bringing about the effacement of said lamp LL. The opening of normal contact 158 of the sleeve relay SL' opens the energizing circuit of the busy relay BU, which relay opens its alternate contacts 183, 184 and 185 to remove ground from the conductors 185, 186 and 187, which conductors lead to the multiple test contacts 16 of the trunk switches FS', rendering the remaining trunks at her position selectable, as the operator has extended the connection to the called subscriber and is now free to receive other trunk connections, providing she is not now establishing local connections, and if she is thus occupied, the trunks are rendered busy in a manner as previously described. The closure of alternate contact 208 of the relay GU closes an energizing circuit for the meter relay MR, traced from battery, through the winding of the meter relay MR, conductor 209, normal contact 210 of meter cut-off relay MO to ground at alternate contact 208 of relay GU, the said meter relay MR now actuating to register a connection. The closure of alternate contact 208 of the relay GU also energizes the meter cut-off relay MO, the circuit being traced from battery through the winding of relay MO to ground at alternate contact 208 of relay GU. The meter relay MO, upon energizing, opens its normal contact 210, preventing further actuations of the meter magnet MR, which meter magnet MR now restores to normal. A circuit for the ringing lamp RL is also established, traced from battery through the lamp RL, normal contact 216 of relay RC', conductor 217, normal contact 218 of ringing trip relay RT', conductor 219, normal contact 214 of relay 215, conductors 205 and 206 to ground at alternate contact 200 of relay SL', and the ringing lamp RL is thus lighted, giving the operator of trunk C a visual indication notifying her that the called subscriber at substation D has as yet not been signaled. To signal the called subscriber at substation D, the operator associated with the trunk circuit C now depresses the proper ringing key plunger of the ringing key RK' to connect the proper ringing frequency from the generators G⁵, G⁶, G⁷ or G⁸, as the case may be, to operate the call signal of the called subscriber at the substation D.

Assuming that it is the generator G⁸ that is the selected frequency for signaling, she

depresses the key plunger of the ringing key RK' associated with the said frequency, and the depression of the said key plunger actuates the end spring contact 211, causing it to momentarily assume its alternate position, and the closure of the said alternate contact 211 established an energizing circuit for the ringing control relay RC', traced from battery through the winding of the said relay RC', conductor 212, alternate contact 211 of the end spring of the ringing key RK', conductor 213, normal contact 214 of the relay 215, conductors 205 and 206 to ground at alternate contact 200 of the sleeve relay SL'. The closing of alternate contact 220 of relay RC' establishes a locking circuit for the said relay RC', traced from battery through the winding of said relay RC', its alternate contact 220, conductor 217, normal contact 218 of ringing trip relay RT', conductor 219, normal contact 214 of relay 215, conductors 205 and 206 to ground at alternate contact 200 of the sleeve relay SL', and the opening of normal contact 216 of relay RC' opens the circuit of the ringing lamp RL. The closure of alternate contact 221 of the relay RC' closes an energizing circuit for the interrupter relay IR', traced from battery through the winding of the relay IR', conductor 222, alternate contact 221 of relay RC', conductor 223, alternate contact 224 of relay SS, conductor 225 and through the constantly rotating interrupter I' to ground. The relay IR' is thus intermittently energized and de-energized by the interrupter I', and the ringing current from generator G⁶ is thus connected and disconnected to intermittently operate the call signal at the called-for substation D. The ringing current may be traced from the ungrounded pole of the generator G⁶, through the closed key plunger contact of the ringing key RK', conductors 226 and 227, through the winding of the ringing trip relay RT', conductors 228 and 229, alternate contact 230 of the interrupter relay IR', the tip contacts of the connected trunk plug TP and jack J', through the condenser and call signal at the called substation D, back through the ring contacts of the connected jack J' and plug TP, to battery and ground through alternate contact 231 of the ringing interrupter relay IR'. The call signal at substation D is thus intermittently energized due to the intermittent energization and de-energization of the interrupter relay IR', and the subscriber at substation D, in response to his call signal, removes his receiver from the switchhook. Should the said subscriber at substation D remove his receiver during a ringing or live period, the combined generator and battery flow through the winding of the ringing trip relay RT' causes the same to actuate, and the opening of its normal contact 218 opens

the locking circuit of the ringing control relay RC', which relay RC' restores, and the opening of its alternate contact 221 disconnects the interrupter I' from the interrupter relay IR', the said relay IR' now restoring to normal and preventing further application of ringing current after the called subscriber at substation D answers in response to his call signal.

Should the subscriber at substation D remove his receiver during a silent period, that is, when the ringing interrupter relay IR' is in one of its de-energized positions, an energizing circuit for the supervisory relay SR' is established, said circuit being traced from battery through the lower winding of the relay SR', conductor 239, winding "d" of the repeating coil RC, normal contact 231 of relay IR', ring contacts of the connected plug TP and jack J', through the now closed contacts at the substation switchhook at substation D, back through the tip contacts of the connected jack J' and plug TP, normal contact 230 of relay IR', alternate contact 240 of the sleeve relay SL', winding "c" of the repeating coil RC, conductor 241, through the upper winding of the relay SR' to ground.

The closure of alternate contact 242 of the relay SR', upon its energization, establishes an energizing circuit for the relay 215, traced from battery through the winding of the relay 215, alternate contact 242 of the relay SR', conductors 243, 205 and 206 to ground at alternate contact 200 of the sleeve relay SL'. Relay 215, upon energizing, opens its normal contact 214 to open the locking circuit of the ringing control relay RC'. In this way, in the event that the subscriber D answers during a silent period, the said relay RC', upon restoration, opens its alternate contact 221, disconnecting the interrupter I' from the ringing interrupter relay IR', the said relay IR' restoring and preventing further application of ringing current. A locking circuit for relay 215 is established upon the closure of its alternate contact 244, traced from battery through the winding of the said relay 215, its alternate contact 244, conductors 205 and 206 to ground at alternate contact 200 of relay SL'. The closing of alternate contact 245 of the supervisory relay SR', places a shunt about the high resistance winding of the test relay T, and the circuit of the supervisory relay SR of the cord circuit B at the exchange M now extends over conductor 150, to alternate contact 245 of relay SR', conductor 246, through the lower winding of the relay T, which winding is of low resistance, conductors 152 and 153 and over the previously described path to the relay SR at the exchange M. The relay SR of the cord circuit B at the exchange M now energizes due to the shunt about the high

winding of relay T of trunk C at exchange N, and the opening of its normal contact 83 opens the circuit of the calling supervisory lamp CL, bringing about the effacement of the said lamp CL and notifying the operator of the cord circuit B at the exchange M that the called subscriber at the substation D at the exchange N has answered. The subscriber at the substation A at the exchange M and the subscriber at the substation D at the exchange N are now in conversational circuit, and the talking circuit may now be traced over the heavily marked conductors.

Assuming that the subscribers have finished conversation, they replace their receivers upon their respective switchhooks. The replacing of the receiver by the subscriber at the substation A of the exchange M opens the circuit of the sleeve supervisory relay AS of the cord circuit B and the closing of its normal contact 52 establishes an energizing circuit for the disconnect relay LD, traced from battery through the winding of the relay LD, normal contact 52 of relay AS, alternate contact 250 of relay ST, conductor 85 to ground at alternate contact 75 of sleeve relay SL. The link disconnect relay energizing disassociates the calling line from the strands of the cord circuit at its normal contacts 48 and 49 and closes a locking circuit for the relay ST extending from battery through the said relay, its alternate contact 43, conductor 41, alternate contact 42 of relay LD, alternate contact 250 of relay ST to ground at alternate contact 75 of relay SL. The relays LD and ST remain energized until the connection is taken down. The opening of normal contacts 48 and 49 of relay LD allows the cut-off relay CO of the line circuit L to restore, which places the line circuit L at normal.

The closing of normal contact 52 of relay AS closes a circuit for the answering supervisory lamp AL, traced from battery through the lamp AL, normal contact 52 of relay AS, alternate contact 250 of relay ST, conductor 85 to ground at alternate contact 75 of relay SL. The answering supervisory lamp AL is lighted, notifying the operator that the subscriber at the calling substation A has replaced his receiver upon the switchhook. The subscriber at substation A may immediately initiate a recall before the answering and calling plugs AP and CP are removed, by again removing his receiver which again brings about the energization of the line relay LR, which relay, upon energization, closes the circuit for the multiple line lamps S, and the same operator or another operator may seize the recall.

The subscriber of the substation D at the distant exchange N now places his receiver upon the switchhook to open the energizing circuit of the supervisory relay SR' of the trunk circuit C. Upon the restoration of the relay SR', its alternate contact 245 is again opened, removing the shunt from about the high resistance winding of test relay T, and the circuit of the supervisory relay SR of the cord circuit B at the exchange M again extends through the winding of the high resistance test relay T, and the circuit through the relay T of the trunk circuit C of exchange N allows relay SR of cord circuit B to restore, due to the high resistance of the test relay T, and the closure of its normal contact 83 again closes a circuit through the supervisory lamp CL, notifying the operator at the exchange M that the called subscriber at the substation D at the exchange N has replaced his receiver. The operator at the exchange M, noting the two lighted supervisory signals AL and CL, removes the answering plug AP from the jack J and the calling plug CP from the trunk jack TJ. The removal of the plug CP from the trunk jack TJ opens the energizing circuit of the line relay LR' associated with the trunk jack TJ and the sleeve relay SL of the cord circuit B of exchange M, and the line relay LR', upon restoration, opens its alternate contact 107, opening the series energizing circuit of the cut-off relay CO' and the relay BG of the finder switch FS. The relay BG, upon de-energization, closes its normal contact 95, closing an energizing circuit for the release relay RR of the said switch FS, the circuit of the release relay RR being traced from battery through the winding of relay RR, alternate contact 93 of relay SH, conductor 94 to ground at normal contact 95 from relay BG. The release relay RR, upon energization, removes the retaining pawl from the ratchet, allowing the wipers 2, 3, 4 and 5 to restore to their normal position under spring tension, and when the wipers have restored to normal, off-normal contacts ON are moved to again assume their normal position, and the opening of alternate contact 114 of off-normal contact ON opens the locking circuit of the switching relay SH, which relay SH restores to normal, and the opening of alternate contact 93 of said relay SH opens the circuit of the release relay RR, which relay RR also restores. The finder switch FS is now at normal and is available for extending other trunk connections.

The removal of the plug CP from the trunk jack TJ at the outgoing end of the exchange M opens the circuit of the high resistance test relay T of the trunk circuit C at the exchange N and the relay T, upon de-energization, opens its alternate contact 154, which brings about the restoration of the relay SS. The relay SS, upon de-energization, opens its alternate contact 176 and opens the locking circuit through the lower

winding 206 of the relay GU, but the relay GU does not restore at this time due to the locking circuit through the upper winding 201 to ground at alternate contact 200 of the sleeve relay SL'. The closure of normal contact 176 of the relay SS establishes a circuit for the disconnect lamp DL traced from battery through the lamp DL, alternate contact 270 of relay SL', conductor 271 to ground at normal contact 176 of the relay SS. The disconnect lamp DL is lighted over this circuit and notifies the operator at the exchange N that disconnection has taken place at the exchange where the call originated. The opening of alternate contact 156 of the relay SS allows the relay 160 to restore, and the opening of alternate contact 180 of the relay SS permits the de-energization of the cut-off relay CO² of the trunk switch FS'. The relay 160 is made slow to release so that when its energizing circuit is opened, its contact 272 is held momentarily open due to its slow to release construction, permitting the said cut-off relay CO² to fully de-energize. The relay CO² upon restoration places the switch FS' in condition to be used for selecting purposes. The operator at the trunk circuit C having as yet not withdrawn the plug TP from the jack J', the locking circuit through the upper winding 201 of the relay GU is still maintained, and the closing of normal contact 272 of the relay 160 now places a ground upon the test conductor 182 which leads to the test contacts 16 of the trunk switch FS' to which the trunk circuit C is multiplied, the ground extending from ground at alternate contact 273 of relay GU over conductor 274, normal contact 272 of relay 160, conductors 181 and 182 to the test contact 16. The ground from the said alternate contact 273 places a ground or busy potential upon the test contact 16, thus preventing any other finder switch FS' from selecting the trunk circuit C that is still connected to the called line D. The operator noting the lighted disconnect lamp DL, knows that the operator at the exchange M has withdrawn the plugs of the cord circuit B from the respective jacks and she now withdraws the trunk plug TP from the jack J' of the called line. The removal of the plug TP opens the series energizing circuit for the sleeve relay SL', and the cut-off relay CO³ and the opening of alternate contact 200 opens the locking circuit through the winding 201 of the relay GU, and the opening of the said alternate contact 200 of sleeve relay SL' also opens the locking circuit of the relay 215. The opening of alternate contact 270 of the sleeve relay SL' brings about the effacement of the disconnect lamp DL. The relay GU upon de-energization opens its alternate contact 273, removing ground from the test conductor 182 which extends to the test contacts 16, thus

removing the busy potential of the said contacts 16, now rendering the trunk circuit C at the exchange N selectable by other trunk switches FS'. The opening of alternate contact 208 opens the circuit of the meter cut-off relay MO, the said relay MO restoring to normal. The apparatus that was used in establishing the connection from the calling subscriber at the substation A at the exchange M to the called subscriber D at the exchange N is now at normal and available for establishing other connections.

While we have illustrated and described a specific form of our invention, we do not wish to be limited to the same, as changes and modifications will readily suggest themselves to those skilled in the art, and we, therefore, aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. A telephone system including a plurality of outgoing trunk jack terminals, a plurality of incoming trunk plug terminals, finder switches and non-preselecting non-restoring trunk switches intermediate said outgoing jack and incoming trunk plug terminals, manually operated cord circuits having connection terminals, and means for operating one of said finder switches and one of said trunk switches when connection is made by one of said manually operated cord circuits with one of said outgoing trunk jack terminals to connect one of said outgoing trunk jack terminals to one of said incoming trunk plug terminals.

2. A telephone system including an outgoing trunk jack terminal and an incoming trunk plug terminal, a pair of non-numerical non-preselecting trunking switches intermediate said terminals, a manually operated cord circuit having connection terminals, and means for causing an operation of said non-numerical non-preselecting switches when connection is made by said cord circuits with said outgoing trunk jack terminal to connect said outgoing trunk jack terminals to said incoming trunk plug terminal.

3. A telephone system including an outgoing trunk jack terminal and an incoming trunk plug terminal, an operator's cord circuit, a finder switch intermediate said terminals, means for causing the operation of said finder switch when connection is made by said operator's cord circuit with said outgoing trunk jack terminal to connect said outgoing trunk jack terminal to said incoming plug trunk terminal, and means for restoring said finder switch, said restoring means controlled solely by the operator at said cord circuit and independently of the subscribers' telephone lines.

4. A telephone system including an out-

going trunk jack terminal and an incoming trunk plug terminal, a non-numerical non-restoring switch having bank contacts and contact wipers for engaging the same intermediate said trunk terminals, and means for causing the operation of said switch when connection is made with said outgoing trunk jack terminal, to connect said outgoing trunk jack terminal to said incoming trunk plug terminal via a set of said bank contacts and said contact wipers, said contact wipers remaining in engagement with the set of bank contacts last engaged when said connection is taken down.

5. A telephone system including an outgoing trunk jack terminal appearing before an operator's position at an exchange and a plurality of incoming trunk plug terminals terminating at a distant exchange, a subscriber's telephone line, an operator's cord circuit for said operator's position for interconnecting said line and said trunk jack terminal, a non-numerical non-restoring switch, said switch being adapted when said outgoing trunk jack terminal is seized upon the connection of said cord circuit with said trunk jack terminal to connect said outgoing trunk jack terminal to the incoming trunk plug terminal on which the wipers of said switch are resting if said incoming trunk plug terminal is idle, and automatic means controlled over said subscriber's line for freeing said subscriber's line from said cord circuit without affecting the said switches.

6. A telephone system including an outgoing trunk jack terminal and an incoming trunk plug terminal, a subscriber's telephone line, an operator's cord circuit for interconnecting said telephone line and said trunk jack terminal, a finder switch and a non-numerical non-preselecting and non-restoring trunking switch tied tail to tail intermediate said trunk terminals, means for operating said switches to connect said outgoing trunk jack terminal to said incoming trunk plug terminal, and means for said cord circuit for freeing said line from said cord circuit without affecting the operation of said switch.

7. A telephone system including subscribers' telephone lines, a plurality of outgoing trunk jack terminals appearing before operators' positions at an exchange, link circuits for said operators' positions for interconnecting the subscribers' telephone lines and said trunk jack terminals, a plurality of incoming trunk plug terminals terminating in an operator's position at a distant exchange, pairs of non-numerical automatic switches intermediate said outgoing jack and said incoming plug trunk terminals, means responsive to the connections of a link circuit at said first exchange to one of said trunk jack terminals to cause an idle

pair of said switches to connect said outgoing trunk jack terminals to an idle one of said incoming trunk plug terminals at said distant exchange, and means at said first exchange for permitting the operator thereat to converse with the operator at the distant exchange over the conductors of the trunk circuit controlled by said pair of switches.

8. A telephone system including a multi-exchange telephone system including a plurality of outgoing trunk jack terminals extending towards each of the exchanges in the system, a plurality of incoming trunk plug terminals at each exchange accessible from the other exchanges, trunk circuits extending between each of said exchanges terminating at their opposite ends in non-numerical non-preselecting trunking switches, the said switches terminating in the trunk plug terminals being also non-restoring, and means for setting in operation a non-numerical switch of one of said trunk circuits associated with an outgoing jack terminal to connect said trunk circuit to said outgoing jack terminal when connection is made with an outgoing trunk jack terminal and for setting in operation a non-numerical switch associated with the opposite end of said trunk circuit at another of said exchanges to connect said trunk circuit to an idle one of said incoming trunk plug terminals at said latter exchange.

9. A telephone system including two telephone exchanges, outgoing trunk jack terminals at one of said exchanges and incoming trunk plug terminals at the other of said exchanges, trunks extending between said exchanges and terminating in their opposite ends in non-numerical non-preselecting trunking switches, the said switches at the incoming trunk plug terminals being also non-restoring, and means for setting in operation one of said non-numerical switches at the first of said exchanges when connection is made with one of said outgoing trunk jack terminals to connect one of said trunk circuits to one of said outgoing trunk jack terminals and for setting in operation the switch associated with the other end of said trunk circuit at the other exchange to connect said trunk circuit to one of said incoming trunk plug terminals at said other exchange.

10. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of said positions, trunk circuits, outgoing terminals at each operator's position and incoming terminals at the operators' positions in the other exchanges whereby each operator's position may be connected over said trunks to operators' positions in the other exchanges, non-numerical automatic switches for connecting the

outgoing and incoming terminals of said trunk circuits, and control circuits whereby when an operator is answering a call at her position from a telephone line or an incoming trunk all incoming trunks leading to her position will be rendered inaccessible.

11. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of said positions, trunk circuits, outgoing terminals at each operator's position and incoming terminals at the operators' positions in the other exchanges whereby each operator's position may be connected over said trunks to operators' positions in the other exchanges, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunk circuits, and a common relay associated with each operator's position for rendering the incoming trunk circuits associated with her position busy.

12. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of said positions, trunk circuits, outgoing terminals at each operator's position and incoming terminals at the operators' positions in the other exchanges whereby each operator's position may be connected over said trunks to operators' positions in the other exchanges, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunk circuits, an operator's busy relay, connections extending from said relay to each of the incoming trunk terminals at an operator's position, and means including said connections whereby when a call is being answered at said operator's position said relay is operated to render all of said incoming trunk terminals busy.

13. A telephone system comprising telephone lines terminating in different exchanges, link circuits at each of said exchanges, trunk circuits, outgoing terminals for said trunk circuits at said exchanges, incoming trunk terminals for said trunk circuits at said exchanges, non-numerical automatic switches for connecting said outgoing trunk terminals to said incoming trunk terminals, and control circuits whereby when a call is extended to an operator's position of one of said exchanges all the trunks leading from said operator's position of said exchange are rendered inaccessible.

14. A telephone system including telephone lines terminating at different exchanges, link circuits at each of said exchanges, trunk circuits adapted to be extended from one of said exchanges to each of the other of said exchanges, incoming and outgoing terminals for said trunk circuits, means including one of said link circuits, an outgoing trunk terminal, an auto-

matic switch and an incoming trunk terminal for extending a call from a subscriber's line of one of said exchanges to a subscriber's line of another of said exchanges, means responsive to the extension of said connection for connecting the operator's telephone associated with the incoming trunk terminal to the said link circuit and for rendering all the incoming trunk terminals associated with the operator's telephone inaccessible.

15. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of such positions, trunk jacks accessible from each of said positions and having outgoing trunk circuits, incoming trunk circuits at each operator's position in the different exchanges, non-numerical automatic switches intermediate of said outgoing and incoming circuits terminating at connecting plugs at A or subscribers' operators' positions in all of the other exchanges whereby each subscriber's operator may effect connection between telephone lines accessible from her position or may extend connections from calling lines accessible from her position through said subscribers' cord circuits and said trunk circuits to operators' positions at distant switchboards through the agency of said switches, and a common relay associated with each operator's position for rendering the incoming trunk circuits associated with her position busy.

16. A telephone system comprising telephone lines terminating at operators' positions, subscribers' cord circuits at each of such positions, trunk jacks having outgoing trunks extending from each operator's position to plug terminals at other operators' positions whereby each operator's position has both jack and plug terminals of outgoing and incoming trunks at her position, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunk circuit, said cord and trunk circuits having control circuits whereby each operator may effect connection between telephone lines accessible from her position by said cord circuits or may extend connections from calling lines accessible from her position through said subscribers' cord circuit and said trunk circuits to operators at distant positions, through the agency of said non-numerical automatic switches, and means associated with the distant ends of the trunk circuit extending from an operator's position to a distant exchange for rendering all incoming trunk circuits at the said distant exchange busy.

17. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of such positions, trunk

jacks having outgoing trunks extending from each operator's position to plug terminals at other operators' positions whereby each operator's position has both jack and plug terminals and outgoing and incoming trunks at her position, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunks between different exchanges, and control circuits for rendering inaccessible the incoming trunks of an operator's position whenever a call is being answered at her position from a telephone line or from an incoming trunk at her position.

18. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of said positions, trunk circuits, outgoing terminals at each operator's position for such circuits terminating at incoming terminals at operators' positions in the other exchanges, and non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunks between different exchanges, whereby each operator's position may be connected over said trunks to operators' positions in other exchanges, and busy means for rendering inaccessible all incoming trunks at an operator's position when said operator is answering a call at her position from a telephone line or from an incoming trunk.

19. A telephone system comprising telephone lines terminating at operators' positions in different exchanges, subscribers' cord circuits at each of said positions, trunk circuits, outgoing terminals at each operator's position for such circuits terminating at incoming terminals at operators' positions in the other exchanges whereby each operator's position may be connected over said trunks to operators' positions in other exchanges, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunks between exchanges, busy means for rendering inaccessible all incoming trunks at an operator's position when said operator is answering a call at her position from a telephone line or an incoming trunk, and means for rendering the busy signals at all but the used trunks leading to her position ineffective upon extending an answered call.

20. A telephone system comprising telephone lines terminating in different exchanges, link circuits at each of said exchanges, incoming and outgoing trunk circuits extending from one of said exchanges to each of the other of said exchanges, non-numerical automatic switches for interconnecting said incoming and outgoing terminals of said trunks between exchanges, busy signal means associated with each of said trunk circuits, and control circuits

whereby when an operator is answering a local call at one of said exchanges all the trunks leading to her position will be rendered busy.

21. A telephone system comprising telephone lines terminating in different exchanges, link circuits at each of said exchanges, incoming and outgoing trunk circuits extending from one of said exchanges to each of the other of said exchanges, non-numerical automatic switches for interconnecting said incoming and outgoing terminals of said trunks between exchanges, busy means associated with each of said trunk circuits, and control circuits whereby when a call is extended to one of said exchanges all idle trunks leading to the operator's position attending to the call at said one exchange will be rendered inaccessible to prevent other calls from being extended to said exchange.

22. A telephone system comprising telephone lines terminating at different exchanges, link circuits at each of said exchanges, incoming and outgoing trunk circuits extending from one of said exchanges to each of the other of said exchanges, and a pair of non-numerical automatic switches for interconnecting the outgoing and incoming terminals of said trunks between different exchanges, means including one of said link circuits and an outgoing trunk circuit for extending a call from a subscriber's line of one of said exchanges to a subscriber's line of another of said exchanges through the agency of said switches, and means responsive to the connection of said link to said trunk circuit for connecting the operator's telephone associated with the said trunk circuit to the said link circuit and for causing all of the incoming trunk circuits associated with the operator's telephone to indicate busy.

23. A telephone system comprising subscribers' lines terminating at operators' positions in different exchanges, link circuits at each of said positions, trunk lines extending from one of said exchanges to each of the other of said exchanges, outgoing and incoming terminals for each of said trunk lines, non-numerical automatic switches for connecting the outgoing and incoming terminals of said trunks between different exchanges, means including the said link circuits whereby each subscriber's operator may effect connection between lines associated with her position, and means including said link circuit and one of said trunk circuits for extending connection from a subscriber's line terminating at said first exchange to a subscriber's line terminating at said second exchange, and means for rendering all the idle incoming trunk terminals associated with the operator's position at said first exchange busy when her

telephone is connected to one of said subscriber's lines.

24. A telephone system including telephone lines terminating at a central office exchange, other telephone lines terminating at a second central office exchange, link circuits at each of said exchanges, trunk circuits extending from the first of said exchanges to the second of said exchanges for extending calls to said second exchange, trunk circuits extending from said second exchange to said first exchange for extending calls from said second exchange to said first exchange and terminating in their opposite ends in non-numerical switches for extending said connections, control circuits whereby the connection of a link circuit at said first exchange to a calling subscriber's line operates means to busy the trunks extending from said second exchange to said first exchange, and circuit connections whereby the connection of said link circuit to a called subscriber's line removes the busy indication of said signals.

25. A telephone system comprising telephone lines terminating at an operator's position, operators' cord circuits for interconnecting said lines, trunk circuits extending from said position to other operators' positions, non-numerical automatic switches intermediate said first position and other operators' positions for interconnecting the same, an operator's telephone for the cord circuits and one for the trunk circuits, means for automatically connecting and disconnecting the cord operator's telephone and said cord circuits, and a key individual to each cord circuit whereby the cord operator's telephone may be connected in circuit with the trunk operator's telephone over a conversational circuit independent of that end of the cord circuit distant from the trunk.

26. A telephone system comprising telephone lines terminating at an operator's position in an exchange, outgoing trunk circuits extending from said position to other operator's positions at a distant exchange, cord circuits for interconnecting said lines at said first exchange or said lines and trunk circuits at said distant exchange, non-numerical automatic switches between the outgoing ends of said first exchange and the incoming terminals of said distant exchange for interconnecting said outgoing and incoming terminals of said exchanges, an operator's telephone for the cord circuits and one for the trunk circuits, automatic means for connecting the cord operator's telephone with the cord circuits, telephone lines at said other operator's positions, and order wire keys for said cord circuits for connecting the operator's telephone of a connected cord and a trunk over a conversational circuit including the cord and trunk

but independent of that end of the cord distant from the trunk.

27. A telephone system comprising telephone lines terminating at an operator's position, outgoing trunk terminals extending from said position to incoming terminals at another operator's position, telephone lines terminating at such other position, a cord circuit for interconnecting the first said lines, non-numerical automatic switches intermediate said outgoing and incoming terminals for interconnecting said first lines and lines at other positions, an operator's telephone, automatic means for connecting and disconnecting said operator's telephone and said cord circuit when it is used to establish said first connections, and means whereby when a connection is to be extended from a calling line to a distant line through the agency of said switches, the cord operator may order up the connection for the distant line over a connected cord and trunk to the exclusion of the calling line.

28. A telephone system comprising telephone lines, an operator's link circuit and a trunk circuit, non-numerical automatic switches intermediate said link and trunk circuit, means responsive to the connection of said link circuit to a calling line for connecting the operator's telephone with the link circuit, means responsive to the connection of the link circuit with the trunk circuit to cause said switches to select said link and trunk circuit, means for automatically disconnecting the operator's telephone from the link circuit, and a key for connecting the operator's telephone with the link circuit to the exclusion of the calling line so that the operator may order up a connection.

29. A telephone system including telephone lines, an operator's position having a talking set, a plurality of operators' circuits for interchangeable connection to calling lines, said set arranged for interchangeable connection to said circuits and so to said calling lines, trunk circuits, automatic selecting mechanism for interconnecting said position and an idle trunk circuit, an operator's talking set at the distant end of said trunk circuit, automatic means for interconnecting said two talking sets over a circuit including a portion of one of said operator's circuits connected with a calling line to the telephonic exclusion of said calling line.

30. A telephone system including telephone lines and operators' positions arranged in groups, link circuits adapted for use in linking the lines together for conversation, means whereby an operator extending a connection can select a group of operators, automatic selecting and connecting mechanism for said link circuits, talking circuits for said operators, and control

means for directly connecting the talking circuit of said first operator with an idle talking circuit of the group of operators with the aid of said mechanism.

31. A telephone system including lines, link circuits and operators' positions for controlling the link circuits to interconnect lines, an operator's talking circuit at a position, operator's talking sets at other positions, automatic connecting and selecting mechanisms, multiple terminals for each said talking set testing idle or busy according as their set is idle or busy, and control means for causing one of said mechanisms to automatically connect said talking circuit to a set of idle terminals.

32. A telephone system including telephone lines, link circuits and operators' positions having means for controlling the circuits to interconnect lines, operators' talking circuits at said positions and automatic selecting and connecting mechanism for connecting one operator's talking circuit direct with an idle talking circuit of a group at another operator's position, to enable the operators at the connected circuits to converse.

33. A telephone system including telephone lines, link circuits and operators' positions having means for controlling the circuits to interconnect lines, means for enabling an operator to extend a call by selecting a group of operators having access to a wanted line, automatic non-restoring selecting mechanism for selecting an idle operator of the group, audible signal means for notifying the said first operator of the selecting of the idle operator, a talking circuit for the selected operator and automatic means for interconnecting the talking circuits of said first operator and said second operator.

34. A telephone system comprising calling and called lines, interconnecting link circuits, an operator's position, a distant operator's position, automatic selecting and connecting apparatus connected to a link circuit to extend it toward the called line test means controlled by the listening apparatus at said distant position to prevent such connection from extending to the distant position, and audible signal means at said first position for notifying the operator thereat that the link circuit is being extended toward the called line.

35. A telephone system including telephone lines, an operator's position, an operator's telephone set, link circuits for interconnecting said lines, traveling switches for changing the connections of the link circuits, audible signal means and apparatus for controlling it including automatic means for connecting said operator's telephone set in circuit with said audible signal means to notify the operator at said position that a

switch has selected a link circuit, said automatic means operable to disconnect said operator's telephone set from said audible signal means after selection has been made.

36. A telephone system including telephone lines, link circuits and operators' positions for controlling said circuits to interconnect lines, operators' talking circuits at said positions, an operator's telephone set for each of said positions, automatic selecting and connecting mechanism for connecting said talking circuits in pairs to enable the operators at connected circuits to converse, an audible signal and automatic means for controlling it and for disconnecting the operator's telephone set at one position from said audible signal to notify her that her talking circuit is connected to that of another position.

37. A telephone system including link circuits, telephone lines to be interconnected by said link circuits, an operator's position, selecting switches operable in a single plane for use in operatively connecting calling lines to said position by the aid of said link circuits and automatic means for preventing said switches from connecting said calling lines to said position if the operator thereat is busy establishing connections with lines at her position either as calling or called lines.

38. A telephone system including calling and called lines, interconnecting link circuits, selecting switches for interconnecting certain of said circuits in establishing connections, an operator's answering plug and apparatus controlled by the insertion of said plug to automatically render some of said circuits unselectable.

39. A telephone system including a plurality of lines and link circuits for use in interconnecting them, automatic selecting switches for extending the link circuits, an operator's plug and apparatus effective on the connection thereof to render a plurality of previously selectable circuits unselectable.

40. A telephone system including a plurality of lines terminating at operators' positions in different exchanges, and link circuits for interconnecting them, selecting switches operable in a single plane for selecting the link circuits, an operator's plug and means controlled on the connection of said plug to render a plurality of previously unselectable circuits selectable.

41. A telephone system including operators' link circuits and automatic apparatus for connecting the operator's telephone to a link circuit, other link circuits and selecting switches controlling apparatus effective for the connection of said telephone to said other circuits, and means for preventing such control while said telephone is connected to said first link circuit.

42. A telephone system including an op-

erator's position, a calling line, link circuits and selecting switches for connecting said circuits to said position, a cord circuit and answering plug therefor, and apparatus
5 automatically effective on the insertion of said answering plug to control the operation of said switches, and automatic means for said cord circuit controlled over said line for freeing said line from said switch
10 without affecting said switch.

43. A telephone system comprising calling and called lines terminating in different exchanges, interconnecting link circuits, an operator's position at one of said exchanges,
15 selecting switches operable in a single plane and controlled from said operator's position for uniting certain of said link circuits to other ones of said position, and automatic means effective on connection by a
20 switch to one of said circuits to render other circuits at said position unselectable.

44. In a telephone system an exchange operator's telephone, an operator's telephone

at a distant exchange, a non-numerical traveling switch and an automatically controlled audible signal for said first operator's telephone, its indication changed when
25 said switch ceases to travel, to permit the first exchange operator to converse over a trunk circuit controlled by said switch with
30 the operator at said distant exchange.

45. In a telephone system a pair of operator's positions located at different exchanges, a non-numerical traveling switch for operatively interconnecting the positions at said
35 different exchanges, an automatically controlled audible signal, its indication changed when said positions are connected, to permit the operators at said connected positions to converse over a trunk circuit
40 controlled by said switch.

Signed by us at Chicago, county of Cook and State of Illinois, this 2d day of February, 1920.

HIRAM D. CURRIER.
GEORGE R. EATON.