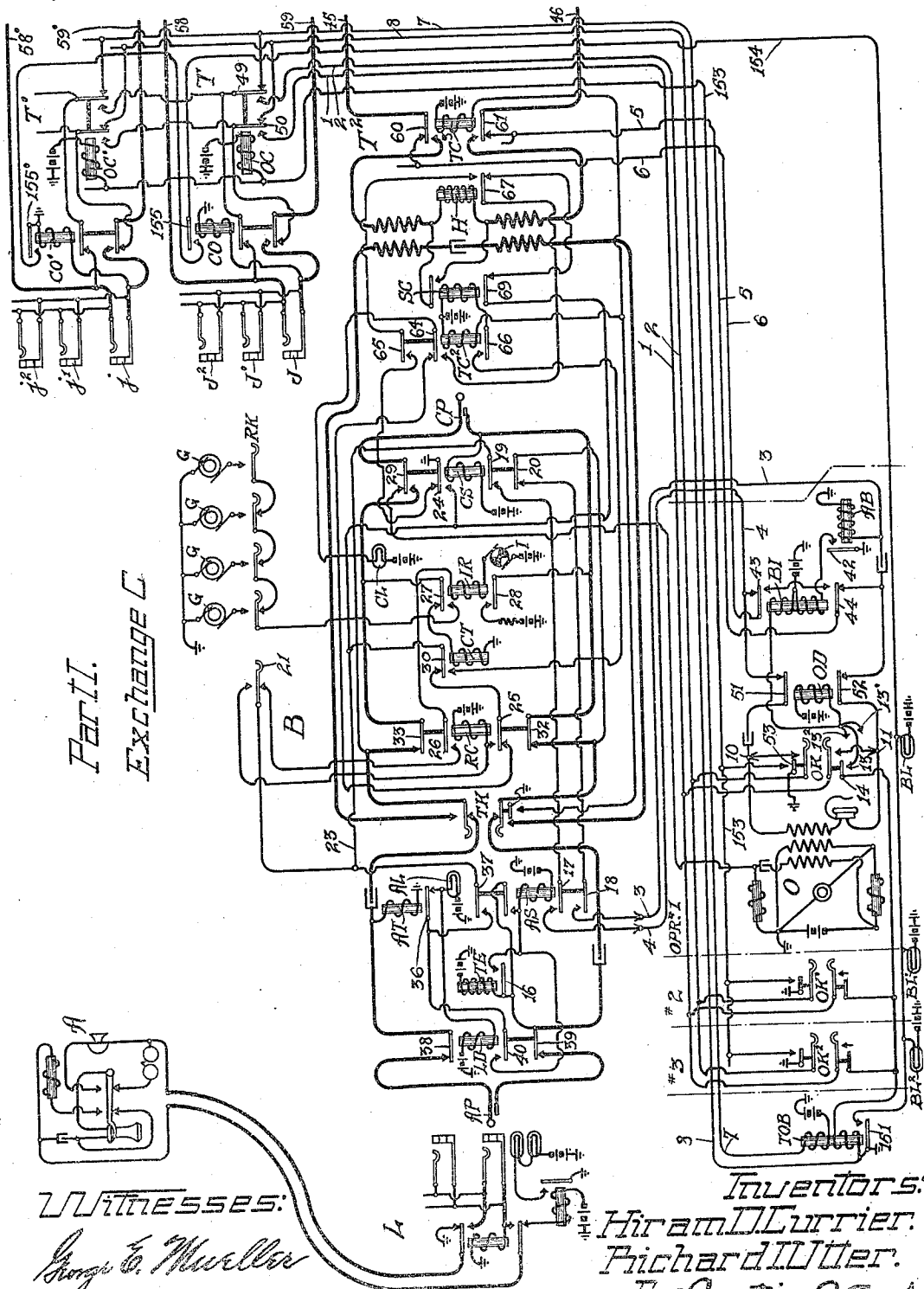


1,238,748.



Witnesses:

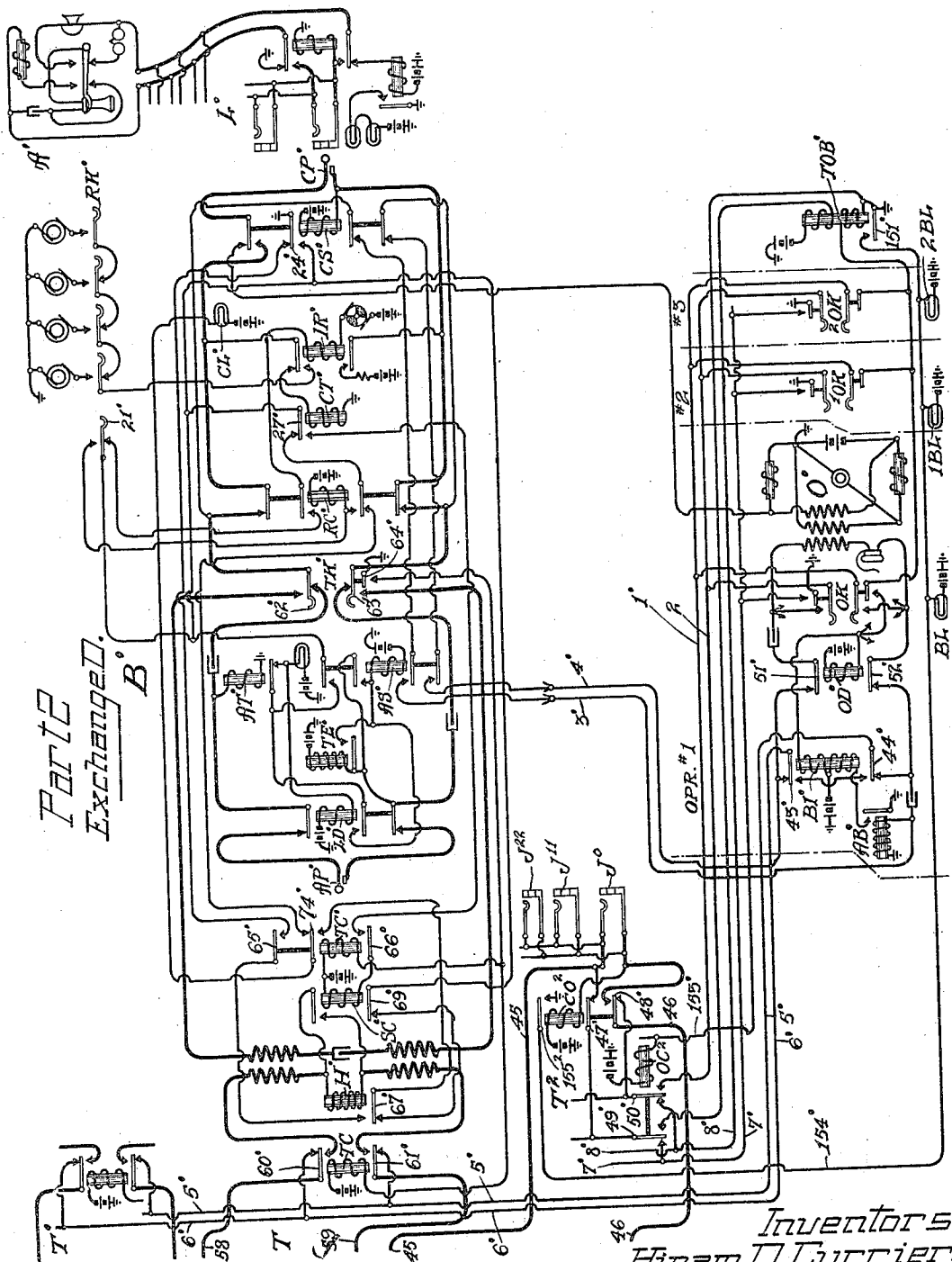
George E. Mueller  
Wm. Bouffalque

Inventors:  
Hiram D. Currier.  
Richard Utter.  
By Curtis & Camp,  
Attorney.

H. D. CURRIER & R. I. UTTER.  
MULTI-EXCHANGE TELEPHONE SYSTEM.  
APPLICATION FILED DEC. 26, 1914.

Patented Sept. 4, 1917.  
2 SHEETS—SHEET 2.

1,238,748.



Witnesses:

George C. Mueller  
John Boughalun

Inventors:  
Hiram D. Currier.  
Richard W. Utter.  
By Curtis S. Camp  
Attorney.

# UNITED STATES PATENT OFFICE.

HIRAM D. CURRIER, OF CHICAGO, AND RICHARD I. UTTER, OF OAK PARK, ILLINOIS,  
ASSIGNORS TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

## MULTI-EXCHANGE TELEPHONE SYSTEM.

1,238,748.

Specification of Letters Patent.

Patented Sept. 4, 1917.

Application filed December 26, 1914. Serial No. 879,068.

*To all whom it may concern:*

Be it known that we, HIRAM D. CURRIER, a citizen of the United States of America, residing in Chicago, and RICHARD I. UTTER, a citizen of the United States of America, residing in Oak Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Multi-Exchange Telephone Systems, of which the following is a specification.

Our invention relates to telephone systems, being directed in general to multi-exchange telephone systems with means for interconnecting the subscribers' stations of the same and different exchanges, one of the main objects of our invention being to provide a system of the above character having improved circuit arrangements whereby the special B or trunking operators are eliminated.

In most of the multi-exchange telephone systems of the manual type, that is, wherein operators are provided for manipulating the cord and trunk circuits, the A operators use operators' 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 who connects the trunk circuit to the wanted line.

In accordance with our present invention, combination operators' cord and trunk circuits are provided whereby an operator may use cord circuits of her position for interconnecting telephone lines terminating thereat or she may receive incoming calls over trunk circuits which may be switched into connection with the calling ends of her cords and in this way use one end of the cord circuit for extending such a trunk connection to lines terminating in her own exchange. Thus one of the features of our invention is the provision of such combination cord and trunk circuits.

Another feature of our invention is an improved trunk circuit also capable of use as an orderwire so that special orderwires between exchanges are eliminated.

Another feature of our invention lies in an improved means for indicating preferably by visual signals when any operator is busy so that the operators at the distant exchanges, by observing signals corresponding to orderwire keys at their positions, can tell at a glance and without any preliminary testing, those operators who are idle and ready to receive trunked calls.

In working out our invention various new features are introduced and these will be more particularly referred to in the ensuing specification and claims.

For a better understanding of our invention reference is to be had to the accompanying drawings comprising parts 1 and 2 which, when joined, illustrate diagrammatically the preferred arrangement of our circuits. All parts have been shown at normal with like reference characters indicating parts having like functions. The apparatus shown in part 1 is located in one exchange and the apparatus in part 2 in another, being connected by the heavily marked trunk conductors terminating at the ends of the sheets. Although in illustrating our invention we have shown a plurality of batteries it is to be understood that those shown in part 1 indicate a single exchange battery and those in part 2 a battery in the corresponding exchange.

Referring now more in general to the preferred form of our invention, it comprises exchanges C and D. At the exchange C a plurality of substations as A are provided terminating in line circuits L before a number of different operators' positions in multiple jacks each of which has a line signal so that when a call is initiated a plurality of such signals 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 circuit including answering and calling plugs AP and CP connected by the heavily marked tip and sleeve conductors with the interposed condensers. At the answering end of the cord circuit an answering sleeve relay AS is provided together with an an-

swering tip relay AT. A test relay TE is also provided being of a high resistance, this relay operating when a called line is connected with so as to connect the answering sleeve relay AS to the sleeve strand of the cord and thus to the cut-off relay and calling line circuit.

As above referred to we have embodied our invention in the so-called associated multiple system, that is a system employing a number of calling line lamps. The first operator to seize the calling line does so to the exclusion of the others for reason of the high resistance test relay TE which operates in the first cord which seizes the line but does not operate in those cords which may be subsequently connected to the calling line.

We also employ instantaneous disconnect and recall and to this end a link disconnect relay LD is provided which is energized when the calling subscriber replaces his receiver and thus disconnects the link conductors so that a recall may be initiated without awaiting the removal of the connected plug.

At the calling end of the preferred form of cord circuit employed, a calling sleeve relay CS and a calling tip relay CT are provided together with a ringing control relay RC and interrupter relay IR, so that automatic ringing may be employed. A party line ringing key RK is also provided being preferably of the indicating type and having a set of common contacts 21 which are momentarily actuated each time a ringing plunger is fully depressed but restored when the plunger assumes its indicating position.

Automatic listening is also provided, this being effected by the connection and disconnection of the operator's telephone O by the answering and calling sleeve relays, respectively.

An operator's telephone O, including the usual transmitter, induction coil and receiver, is common to each operator's cord circuits, and also common to each operator's telephone are relays AB, BI, and OD.

Before each operator a plurality of trunk jacks J,  $j$  are positioned, said jacks being connected to trunk circuits T,  $T^1$  extending to exchange D, said jacks being preferably distributed along the board so that all operators have access to these trunks, jacks J and  $j$  appearing before operator No. 1, jack  $J^1$  and  $j^1$  before operator No. 2, jacks  $J^2$  and  $j^2$  appearing before operator No. 3, etc. Thus, any of the operators have access to the group of trunks including T and  $T^1$ .

In communicating between exchanges the operators use the trunks for ordering up connections and the circuit arrangement is such that as long as there is an idle trunk to the distant exchange, there is, of course, an idle orderwire. The circuit arrangement

also is such that when an operator presses an orderwire key as OK she connects her telephone in bridge of all of the idle trunks of the group extending to the desired exchange, this being brought about by the connection of her telephone to outgoing orderwire conductors 1, 2 and the operation of all of the operators' cut-in relays OC of the selected group, whereby her telephone set is connected through contacts of the relays OC to the idle trunks. As long as a trunk is in use, the combined cut-off and group-busy relay CO is energized so that although the associated operator's relay OC be energized, the relay CO has rendered it ineffective upon the busy trunk.

In exchange C we have shown orderwire keys for three operators' positions, these keys being indicated as OK,  $OK^1$  and  $OK^2$  of operators' positions 1, 2 and 3, respectively. These keys are multiply connected to the outgoing orderwire conductors 1, 2, so that any of the operators may connect a telephone set to the trunks T,  $T^1$ . Upon actuation of any orderwire key OK all busy lamps BL,  $BL^1$ ,  $BL^2$ , etc., of the seized orderwire are illuminated indicating that the particular associated group of trunks are being used for an orderwire. Of course these lamps are only lighted during the period of ordering between operators.

It will be understood that the operators' positions 2 and 3 corresponding to keys  $OK^1$  and  $OK^2$  are also provided with an operator's telephone O and associated apparatus OD, BI and AB, although only keys  $OK^1$  and  $OK^2$  are shown at the positions 2 and 3.

Should the orderwire key OK be depressed, the operator's telephone-disconnect relay OD is energized to disconnect the listening conductors 3, 4 from her telephone set so that conversation over the orderwire cannot be interfered with or overheard by the calling subscriber. The closing of contact 53 of the key, operates the relays OC of the corresponding group of trunks.

Referring again to trunks T,  $T^1$ , these extend preferably to a single operator in exchange D, the trunk T at exchange D being fully illustrated, but only a portion of  $T^1$ , both trunks of course being the same. Each trunk T is preferably individual to a cord circuit B<sup>1</sup>, a trunk key  $TK^1$  being provided for each cord for converting it from an operator's cord circuit into the incoming end of a trunk. Thus, if a connection is to be extended over the trunk T to the cord B<sup>1</sup>, the actuation of key  $TK^1$  will disconnect the answering end of the cord and connect the trunk T in place thereof, the actuation of key  $TK^1$  also causing the energization of trunk connecting relays TC and  $TC^1$ . Thus the high resistance relay H is placed in series with the bridged tip and sleeve relays CS and CT of cord B, causing the actuation

of H but not permitting the energization of the tip relay CT until the cord calling supervisory signal control relay CS has been operated when the called subscriber responds.

5 We preferably arrange the trunks in groups with their outgoing ends, that is the jack J end, multiplied before all of the operators in the exchange and with each group terminating at their incoming ends, before a  
10 single operator. However, each operator may have several such groups of outgoing trunks to each exchange, each group terminating at its incoming end before a single operator. Each operator has incoming  
15 trunks from one exchange only but there may be two or more operators in one exchange each having a group of trunks from the same exchange. For instance the group of trunks including T and T<sup>1</sup> in exchange  
20 C terminate at the position of operator #1 in exchange D, the orderwire buttons OK, OK<sup>1</sup>, and OK<sup>2</sup> at exchange C being provided at the operators' positions of exchange C for this group of trunks.

25 Assuming a second set of outgoing trunks are provided from exchange C to exchange D, such trunks would be multiplied before the exchange C operators and connected to a pair of outgoing orderwire conductors 1,  
30 2 multiplied to corresponding orderwire keys at the different operators' positions. Each such key would be multiply connected to the corresponding operator's telephone O at points 10 and 11, the contacts 53 of this  
35 second set of keys being connected to a conductor as 153 extending to the relays OC of this second group of trunks. The contact 13 of each key would be connected to the corresponding operator's relay OD as is  
40 indicated by the multiple contacts 13<sup>1</sup>, 13<sup>2</sup>. The contacts as 14 of the orderwire keys corresponding to this second set of trunks would be connected to a relay TOB individual to said second set of trunks. Thus it  
45 will be seen that no matter which orderwire key of her set an operator may actuate, her relay OD is operated to disconnect her telephone from the answering conductors 3, 4 but the relays TOB and OC of the selected  
50 group of trunks only are operated, these last said relays being individual to the selected key and set of trunks. That is, there is a relay TOB for each set of trunks, said relay being connected thereto by com-  
55 mons 7, 8.

Thus it will be seen that the actuation of an orderwire key will also operate the corresponding relay TOB to light the corresponding busy lamp as BL and thus indicate to  
60 the other operators that have access to the corresponding trunks that they are being used for orderwire purposes.

Each operator who is provided with incoming ends of trunks such as T<sup>2</sup> at oper-  
65 ator No. 1 exchange C, has a pair of incom-

ing orderwire conductors 5, 6 connected to her telephone and in bridge of all the incoming trunks at her position. It will be remembered that the preferred arrangement is to have each operator provided with in-  
70 coming trunks from one exchange only. Therefore as long as an operator is busy answering calls one or both of the busy relays AB, BI, are operated so that the incoming conductors 5, 6 of her position are  
75 connected together resulting in the operation of the relay as TOB<sup>1</sup> corresponding to her set of incoming trunks so that her busy condition is indicated to the operators at the distant exchange having access to the trunks  
80 terminating at her position. In as much as the incoming orderwire conductors 5, 6, are connected in bridge of all the incoming trunks of the group terminating at her position, it will be seen that an operator is  
85 available as long as there is an idle trunk in the group incoming to her position.

Whenever a set of trunks is in use and is connected to at its jack end, all of the cut-off relays CO of said group of trunks are en-  
90 ergized and therefore the conductor 154 which extends serially through the contacts 155<sup>1</sup> of these relays is connected to ground so that the busy lamps BL corresponding to this group of trunks are lighted.  
95

From the foregoing it will be understood that at the outgoing end of each set of trunks, conductors 1—2, 7—8, 153, and 154 are common and at the incoming end of each set of trunks the incoming orderwire con-  
100 ductors 5, 6, are common.

At exchange D the individual circuit arrangements are the same as those shown at exchange C so that the circuits have corre-  
105 sponding reference characters and their likeness will thus be more apparent. The incoming orderwire conductors 5<sup>1</sup>, 6<sup>1</sup> are connected in common to both trunks T and T<sup>1</sup> and it will be understood that the outgoing orderwire conductors 7<sup>1</sup>, 8<sup>1</sup> are to be connect-  
110 ed to all of the trunks as T<sup>2</sup> of the corresponding group, although but a single trunk is shown. Likewise conductors 153<sup>1</sup>, and 154<sup>1</sup>, are common to the corresponding  
115 group of trunks.

To the end that an operator seeking a trunk connection may see at a glance what distant operators in the desired exchanges are idle, we have arranged the busy lamps BL in such a way that as long as an operator  
120 is in the act of answering any call, the lamps associated with the out-going ends of the trunks extending to her position will indicate such a busy condition.

Having described in a general way the  
125 preferred arrangement of our invention, we will now describe in general the method of extending local and trunk connections.

Referring to exchange C, and assuming that two local substations are to be connect-  
130

ed, a cord circuit B is used by connecting the answering plug AP to the calling line and the calling plug CP to the called line.

As previously referred to, automatic listening is employed, and therefore, when the answering plug AP of the cord circuit is inserted into the jack of a calling line, the listening conductors 3, 4, are connected in bridge of the cord circuit, whereby the operator's answering busy relay AB operates to cause the energization of the associated busy indicating relay BI which in turn connects the incoming orderwire conductors 5, 6, so that the lamps BL, <sup>1</sup>BL, <sup>2</sup>BL in exchange D are lighted. Thus the operators at these positions are apprised of the fact that the operator to whose position orderwire keys OK, <sup>1</sup>OK and <sup>2</sup>OK have access, is busy.

As soon as said operator No. 1 at exchange C completes such local connection, the listening conductors 3, 4, are disconnected and relays AB and BI restore, and efface lamps BL, <sup>1</sup>BL, <sup>2</sup>BL in exchange D indicating to the operators at these lamp positions that the said operator at exchange C is again idle.

Assuming that a trunk connection is to be set up, upon initiation of a call No. 1 operator inserts the answering plug AP operating relays AD and BI, as above, thus indicating her busy condition by the illumination of lamps BL, <sup>1</sup>BL and <sup>2</sup>BL at the distant exchange as before referred to.

Ordinarily an operator has 15 or more cord circuits like B at her position, and the trunks as T<sup>2</sup> associated with the different cords of her position are preferably incoming from one exchange, and as the incoming orderwire conductors 5, 6, are connected to all of these incoming trunks as T<sup>2</sup>, the crossing of these conductors 5, 6, by the operation of relay BI lights lamps BL, <sup>1</sup>BL and <sup>2</sup>BL of exchange D. It will thus be seen that while operator No. 1 is putting up a connection referred to, her busy condition is indicated to all operators having access to her position.

The No. 1 operator having ascertained the calling line desires connection with a line in exchange D, depresses the orderwire key OK at her position, this act connecting her set O to outgoing orderwire 1, 2 and at the same time operating relay OD to disconnect her listening conductors 3, 4 from cord B so that the calling subscriber does not hear her order up the connection. Also responsive to key OK busy indicating relay TOB is actuated to light the lamps BL, <sup>1</sup>BL and <sup>2</sup>BL, so that the other operators will not attempt to connect with this same group of trunks, while being used by operator No. 1 of exchange C.

Relays OC at all the outgoing trunks T, T<sup>1</sup>, etc., of the selected group are also actuated due to the closing of the alternate

ground 53 of key OK and outgoing orderwires 1, 2, are connected to these trunks T<sup>1</sup>. No. 1 operator of exchange C now converses with operator No. 1 exchange D, over a path including all idle trunks T of the group, to the incoming orderwire conductors 5<sup>1</sup>, 6<sup>1</sup> extending to operator No. 1 exchange D.

The originating operator now calls for the number in the distant exchange, and the distant operator assigns the trunk T, whereupon the originating operator restores the orderwire key OK, and inserts the calling plug CP into the jack J. This energizes cut-off relay CO, and prevents any operator from connecting her outgoing orderwire conductors 1, 2, with trunk T. At the time the distant operator assigned trunk T, she actuated the trunk key TK<sup>1</sup> of cord B<sup>1</sup> associated with trunk T, thereby operatively connecting the trunk and cord, and disconnecting the answering end of the cord B<sup>1</sup>. The actuation of key TK<sup>1</sup> operates relays TC and TC<sup>1</sup> so that the trunk talking conductors of T are removed from the common orderwire connection 5<sup>1</sup>, 6<sup>1</sup>.

At the time operator No. 1 in exchange C depressed her order key OK to communicate with operator No. 1 in exchange D, relay BI was energized to short circuit conductors 5, 6, this in turn short circuiting the talking conductors of trunk T<sup>2</sup> and thus conductors 7<sup>1</sup>, 8<sup>1</sup> of exchange D resulting in the operation of trunk operated busy relay TOB<sup>1</sup>, whereby lamps BL, <sup>1</sup>BL and <sup>2</sup>BL are lighted to indicate to the corresponding operators that the group of trunks T, T<sup>1</sup> are in use for orderwire purposes. Therefore the operators in exchange D having access to these trunks will not attempt a connection therewith while the said lamps are lighted. As this short circuit exists only during the ordering and connecting period of the operators of exchanges C and D, the referred to busy indications exist only during this period.

The operator at exchange D having received the number of the wanted line, inserts the calling plug CP<sup>1</sup> into the jack thereof and then applies the proper ringing current to the line.

The operator at exchange C having restored the key OK and inserted the calling plug CP into the jack J of the assigned trunk T caused the restoration of relays OD, BI and AB, whereby the previously referred to busy indications at the distant exchange D and other operators' positions of exchange C are removed.

#### Operation.

We will now describe more in detail the operation of the system in establishing a connection between two lines terminating at a single exchange.

In initiating a call a subscriber removes

the receiver at substation A thereby operating the line relay and lighting the associated line lamps. The first operator to seize the call by the insertion of an answering plug AP, connects the cut-off relay and test relay TE in series effecting the energization of TE but not the cut-off relay due to the comparatively high resistance of relay TE. Therefore relay TE closes its alternate contact 16 connecting answering sleeve relays AS in circuit with the cut-off relay effecting the energization of both followed by the energization of the answering tip relay AT so that the answering supervisory lamp AL does not light.

By the operation of AS and the closing of its alternate contacts 17, 18, listening conductors 3, 4, are connected through normal contacts 19, 20, in bridge of the talking conductors of the cord so that the operator's telephone O is automatically connected to the calling line.

Should a second operator insert an answering plug AP subsequent to the insertion of the first plug, the test relay TE of this second cord circuit will not operate due to the shunting effect of the relay AS of the first cord so that the second operator is unable to communicate with the calling subscriber and knows that the call has been seized by another operator.

When plug AP is inserted and relay AS energized, answering busy relay AB is operated over a circuit including conductor 3, alternate contact 18, normal contacts 20, 32, and relay CS to battery. However, relay CS does not energize due to the high resistance of relay AB. Responsive to operation of AB, relay BI is operated to close its alternate contacts 43, 44, and thus cross the incoming orderwire conductors 6, 5, so that the trunk conductors 45 and 46 are crossed, and tracing this circuit through normal contacts 47<sup>1</sup>, 48<sup>1</sup> at relay CO<sup>2</sup> of T<sup>2</sup>, normal contact 49<sup>1</sup>, 50<sup>1</sup> and conductors 7<sup>1</sup>, 8<sup>1</sup>, to ground and battery through relay TOB<sup>1</sup>, it will be seen that the last said relay is operated to light lamps BL, <sup>1</sup>BL and <sup>2</sup>BL. Thus the operators at exchange D that have access to operator No. 1 of exchange C are apprised of her busy condition. Therefore should they desire to extend a trunking connection to exchange C they will communicate over some other set of trunks than that set including trunk T<sup>2</sup>.

The operator now ascertains the number of the wanted line and inserts the calling plug CP into a jack thereof, (which line is similar to that of A) thereby connecting the cut-off relay of this line and the calling sleeve relay CS in series and effecting the energization of both. It will be noted that normal contacts 19, 20 are interrupted when relay CS energizes; thereby automatically disconnecting the operator's telephone from

the cord. This effects the restoration of relays AB, BI, and TOB<sup>1</sup> so that lamps BL, <sup>1</sup>BL, <sup>2</sup>BL are effaced.

When plug CP is inserted, lamp CL is lighted but is again effaced when the ringing key is actuated, due to the interruption of normal contact 25 of relay RC.

The operator now actuates the proper plunger of the ringing key RK to connect a ringing generator G of the proper frequency to the called line, the full actuation of the plunger causing a momentary actuation of the common contact 21 whereby the ringing control relay RC is energized over a path traced from battery through the winding of the relay, alternate contact 21, conductor 23 to ground at alternate contact 24. Relay RC therefore operates and locks itself through its alternate contact 25 to the previously mentioned ground. Upon the return of the ringing plunger to its indicating position the generator contact remains closed but contact 21 returns to its normal position establishing an operating circuit for the interrupter relay IR traced from battery through the interrupter I, the winding of IR, alternate contact 26, normal contact 21, conductor 23, to ground at alternate contact 24. Relay IR is therefore periodically energized to operate its contacts 27, 28 whereby ringing current and calling tip relay CT are alternately connected in bridge of the called line.

Upon response of the called subscriber a circuit for relay CT is established from ground through the winding thereof, normal contact 27, alternate contact 29, through the plug CP and over the called line returning through relay CS to battery. Relay CT therefore energizes interrupting its normal contact 30 to effect the restoration of relay RC whose contact 26 is interrupted to prevent further actuations of the interrupter relay IR. The closing of normal contacts 32, 33 of RC establishes the continuity of the talking conductors of the cord and thus the two substations are connected in a conversational circuit.

When the subscribers have finished conversation they replace their receivers in the ordinary manner to effect the restoration of the tip relays AT and CT, the restoration of CT causing the illumination of calling supervisory lamp CL over a circuit traced from battery through said lamp, normal contacts 64, 25, 30 to ground at alternate contact 24.

At the answering end of the cord the restoration of relay AT establishes an energizing circuit for the link disconnect relay LD and a circuit for lamp AL by the closing of normal contact 36 which is grounded through alternate contact 37 and conductor 23 to ground at alternate contact 24. Relay LD therefore interrupts its normal contacts 38, 130



39 to operatively disconnect the link conductors from the line of substation A so that the line is available for a recall without awaiting the disconnection of the plug AP from the jack. The closure of alternate contact 40 of relay LD maintains the relay AS energized from the ground previously traced to contact 36 of AT.

The operator observing the two signals 10 AL and CL removes the plugs from their respective jacks, the removal of plug CP effecting the restoration of CS whereby its alternate contact 24 is interrupted to remove ground from the locking circuit of 15 relays AS, LD and TE effecting their restoration, so that the cord circuit apparatus is again at normal.

#### *Trunk connection.*

20 We will now describe the operation of the system in establishing a connection between substations A and A<sup>1</sup> of exchanges C and D respectively.

To initiate a call a subscriber at substation A removes his receiver to light his line lamps whereby the first cord circuit connected therewith seizes the call as before described. This connection results in the energization of relays AS, AT and the cut-off relay of the calling line so that by relay 30 AS the operator's telephone O is connected over the listening conductors 3, 4 to the cord circuit and thus to the calling substation.

35 The operator, finding that connection is desired with a substation in exchange D, and noting that the group of trunks corresponding to key OK is available for order purposes, depresses key OK at her position 40 which key extends to the group of trunks including T, T<sup>1</sup>, going to operator No. 1 of exchange D.

At the time the operator's telephone O was connected in bridge of the cord circuit 45 B by the actuation of relay AS, a circuit for the answering busy relay AB was established whereby busy lamps BL, <sup>1</sup>BL, <sup>2</sup>BL corresponding to all orderwire keys OK, <sup>1</sup>OK, <sup>2</sup>OK connected to the particular group 50 of trunks from exchange D extending to operator No. 1 of exchange C, are lighted. And as we preferably have all the incoming trunks at an operator's position coming from one exchange it will be seen that by 55 illuminating lamps BL, <sup>1</sup>BL, <sup>2</sup>BL, the busy condition of OPR No. 1, exchange C, is indicated to the operators of exchange D and they may then communicate with another operator in exchange C over another set of 60 trunks.

This energizing circuit for relay AB, which relay by the way is of a comparatively high resistance, is traced from ground through the winding thereof, listening conductor 3, alternate contact 18, normal con-

tacts 20, 32, the winding of CS to battery causing the energization of AB but not CS. Alternate contact 42 of relay AB is therefore closed causing the energization of busy indicating relay BI which relay closes its alternate contacts 43, 44, short circuiting incoming orderwire conductors 5, 6, thereby also short circuiting or connecting together the tip and sleeve talking conductors 45, 46 of the group of trunks T<sup>2</sup> coming to this operator's position from exchange D. Tracing these conductors 45, 46 of trunk T<sup>2</sup> to exchange D, they follow a path through normal contacts 47<sup>1</sup>, 48<sup>1</sup> and normal contacts 49<sup>1</sup>, 50<sup>1</sup>, conductors 8<sup>1</sup>, 7<sup>1</sup> and relay 80 TOB<sup>1</sup> to battery and ground resulting in the energization thereof. Relay TOB<sup>1</sup> therefore closes its alternate contact 151<sup>1</sup> and lights lamps BL, <sup>1</sup>BL, and <sup>2</sup>BL of the operator's order wire keys in exchange D 85 which control the group of outgoing trunks including T<sup>2</sup> extending to operator No. 1 at exchange C. These operators at exchange D are thus apprised of the busy condition of operator No. 1 at exchange C. As already 90 referred to, these operators at exchange D may be provided with a second set of outgoing trunks to exchange C, which trunks would extend to some other operator than No. 1 at exchange C so that they would 95 not be delayed should one set be busy.

Referring again to operator No. 1 at exchange C, having depressed the proper orderwire key OK as already referred to, its contacts 13, 14 are closed connecting relays 100 TOB and OD in series causing the energization of both, the closing of alternate contact 151 of TOB lighting lamps BL, BL<sup>1</sup> and BL<sup>2</sup>, so that operators No. 2 and No. 3 who also have access to the outgoing orderwires 105 1—2 will not attempt to communicate thereover while these lamps are lighted. By the interruption of normal contacts 51, 52, the operator's telephone O is disconnected from her cord circuit. The closing of alternate 110 contact 53 of OK causes the energization of the operator connecting relays OC in the selected group of trunks T, T<sup>1</sup> extending the operator No. 1 at exchange D and therefore these relays OC connect the outgoing orderwire conductors 1, 2, through the alternate 115 contacts 49, 50 of each relay and the corresponding normal contacts 47, 48 to the talking conductors 58, 59 of all the idle trunks in the group, the circuit then continuing to 120 the distant exchange and through the normal contacts 60<sup>1</sup>, 61<sup>1</sup> of the relays TC of these idle trunks and over the incoming orderwire conductors 5<sup>1</sup>, 6<sup>1</sup>, through normal contacts 43<sup>1</sup>, 44<sup>1</sup> and 51<sup>1</sup>, 52<sup>1</sup> to the operator's telephone O<sup>1</sup>. 125

It will also be noted that when a key OK is thrown, the upper winding of relay BI is energized but as the lower winding is energized by AB while putting up a connection, 130



this upper circuit through BI is not necessary. This upper circuit is useful only when an operator desires to communicate with a distant operator without having a plug AP up. At such time relay BI would energize and indicate the busy condition of the operator.

trunk circuit T, at the same time disconnecting the answering end of the cord B<sup>1</sup>. The closure of alternate contact 64<sup>1</sup> of the key effects the energization of relays TC and TC<sup>1</sup>, the operation of TC disconnecting the incoming orderwires 5<sup>1</sup>, 6<sup>1</sup> and connecting the talking conductors 58, 59 through to the repeating coil. The operation of relay TC<sup>1</sup> connects the cord calling-supervisory-signal control relay SC<sup>1</sup> in circuit to be controlled by the relay CT<sup>1</sup> when the called subscriber responds. Also due to the closing of alternate contacts 65<sup>1</sup>, 74<sup>1</sup>, of relay TC<sup>1</sup>, the calling lamp CL<sup>1</sup> acts as a guide lamp and is illuminated if the operator at exchange C plugs into the assigned trunk prior to the connection of the trunk to the called line, or if the wrong trunk is plugged into by the originating operator, this act would be indicated by the corresponding lamp remaining lighted.

Operator No. 1 at exchange C now calls for the wanted substation from operator No. 1 at exchange D and we will assume the exchange D operator assigns trunk T which corresponds to her cord circuit B<sup>1</sup>. After testing the wanted line in the usual way and also throwing the trunk converting key TK<sup>1</sup> the exchange D operator inserts the calling plug CP<sup>1</sup> in the jack of the called line and presses the proper plunger of her ringing key RK<sup>1</sup>. This of course momentarily actuates the common contact 21<sup>1</sup> so that ringing control relay RC<sup>1</sup> and interrupter relay IR<sup>1</sup> are actuated in a manner as already described so that ringing current is applied to the called line.

When the originating operator inserts the calling plug CP into the trunk jack, relay H<sup>1</sup> of the trunk is connected in series with relays CT and CS, said relay H<sup>1</sup> energizing but due to its comparatively high resistance preventing the energization of relay CT. Thus relay CS being energized and relay CT at normal, the calling lamp CL of cord B is lighted and remains so until the called subscriber responds.

The exchange C operator upon having trunk T assigned for connection restores key OK and then inserts calling plug CP into the jack J thereof, thereby connecting relays CS and CO in series and causing the energization of both. The operation of relay CS disconnects the listening conductors 3, 4 from this particular cord and the operation of CO interrupts normal contacts 47, 48 thereof and thus prevents interference with conversation over trunk T.

We have previously referred to the connection of cord B<sup>1</sup> to the wanted line and the application of ringing current thereto. Upon a response being received from the called substation tip relay CT<sup>1</sup> is energized resulting in the interruption of its normal contact 27<sup>1</sup> to prevent further application of ringing current. The closure of alternate contact 27<sup>1</sup> connects signal control relay SC<sup>1</sup> in circuit with ground at alternate contact 24<sup>1</sup> of CS<sup>1</sup> resulting in the operation of SC<sup>1</sup> and thus shunting relay H<sup>1</sup> whereby its alternate contact 67<sup>1</sup> is interrupted to efface lamp CL<sup>1</sup> of cord B<sup>1</sup>. The connection of the shunt around the winding of relay H<sup>1</sup> results in the energization of relay CT at cord B whereby its normal contact 30 is interrupted effacing the calling lamp CL so that the originating operator knows that the called subscriber has responded.

The restoration of key OK by operator No. 1, of exchange C disconnects telephone O from the outgoing orderwire conductors 1, 2 and also restores relays TOB and OD. Restoration of TOB extinguishes lamps BL, BL<sup>1</sup> and BL<sup>2</sup> so that the other operators in exchange C which have access to orderwire 1, 2, and the group of outgoing trunks T, T<sup>1</sup> know that this group is available for orderwire and out-trunking purposes.

Substations A and A<sup>1</sup> are now connected over the conversational circuit indicated by the heavily marked conductors of the circuits referred to.

The restoration of relay OD effects the restoration of the relays OC corresponding thereto, that is the relays OC of the particular group of trunks T, T<sup>1</sup> extending to operator No. 1 in exchange D.

When disconnection is desired the receivers at substations A and A<sup>1</sup> are replaced, the replacing at substation A resulting in the deenergization of the tip relay AT and the energization of relay LD and the lighting of lamp AL as already described. The replacing of the receiver at A<sup>1</sup> effects the restoration of the tip relay CT<sup>1</sup> resulting in the lighting of supervisory lamp CL<sup>1</sup> over a circuit traced from battery through the

The insertion of plug CP and consequent energization of CS causes restoration of relays AB and BI to interrupt the short circuit across incoming orderwire conductors 5, 6, so that relay TOB<sup>1</sup> at exchange D is restored extinguishing lamps BL, BL<sup>1</sup> and BL<sup>2</sup> whereby the operators thereat are apprised of the fact that the outgoing trunks from their exchange to operator No. 1 at exchange C are available for further orderwire purposes and out-trunking.

Referring again to circuit B<sup>1</sup> at exchange D it will be remembered that the converting key TK<sup>1</sup> was thrown whereby the closure of its alternate contacts 62<sup>1</sup>, 63<sup>1</sup> connected the talking conductors of the cord with

lamp, alternate contact 74<sup>1</sup>, normal contacts 67<sup>1</sup>, 69<sup>1</sup> and alternate contact 24<sup>1</sup> to ground.

Also responsive to the restoration of relay CT<sup>1</sup> at exchange D, and due to the interruption of its alternate contact 27<sup>1</sup>, relay SC<sup>1</sup> restores removing the shunt from around the winding of the high resistance relay H<sup>1</sup> and thus effecting the restoration of the tip relay CT at cord B, which relay restores again lighting lamp CL over the previously traced path. The operators therefore withdraw the inserted plugs from the corresponding jacks, the operator at B<sup>1</sup> also restoring the key TK<sup>1</sup> so that all apparatus is again available for further connections.

We will now assume that the previously described trunk connection has been established and a second trunking connection from exchange C to exchange D is to be established by operator No. 2 of exchange C. Operator No. 2 therefore after having answered a call by inserting an answering plug in the calling line jack would know that the group of trunks including T, T<sup>1</sup> is available and therefore would actuate the corresponding orderwire key OK<sup>1</sup>. Thus she would connect her telephone to outgoing orderwire conductors 1, 2 and also actuate her relay OD and the relay TOB shown, which last relay is of course individual to the said group of trunks. The actuation of relay TOB lights lamps BL, BL<sup>1</sup>, BL<sup>2</sup> to indicate the busy condition of this group of trunks and the actuation of her relay OD disconnects her telephone from the cord circuit used by her. The actuation of OK<sup>1</sup> also operates the orderwire connecting relays OC of this group of trunks but due to the fact that the cut-off relay of trunk T is energized, the orderwire conductors 1, 2 are not connected to this trunk but are connected to trunk T<sup>1</sup> by relay OC<sup>1</sup> and of course to any other idle trunk of the group. Relays AB and BI of operator No. 2 of course also actuated at the time of answering so that the conductors 5, 6, leading to the group of trunks incoming to her position are crossed and thus actuate the busy lamps at the distant exchange corresponding to these last said trunks. This, of course, will be understood from the previous description.

The connecting of No. 2 operator's telephone across conductors 1, 2 will extend her telephone connection over conductors 58<sup>1</sup>, 59<sup>1</sup> and incoming orderwire conductors 5<sup>1</sup>, 6<sup>1</sup>, to operator No. 1 at exchange D so that the connection can be ordered up in a manner as will be understood from the previous description.

As previously referred to when all of the trunks of a group are connected with at their jacks, the corresponding cut-off relays

CO, CO<sup>1</sup>, etc., are energized so that the lamps BL, BL<sup>1</sup>, and BL<sup>2</sup> corresponding to this group are lighted. However, as soon as one trunk of the group becomes idle and the plug is withdrawn from its jack the corresponding cut-off relay restores and thus interrupts the conductor 154 and effaces the lamps.

In the previously described trunk connections we have referred to trunk connections outgoing from exchange C. To extend connections from exchange D to exchange C the operation would be the same and it is believed that in view of the previous description further reference to trunking from exchange D to exchange C is unnecessary.

It will be noted that an operator's telephone is normally in circuit relation with the incoming trunks at her position so that it is only necessary that the operator at the outgoing end of the trunks connect her telephone therewith and she may immediately converse with the operator at the incoming end of the trunk. However, when an operator's telephone is connected to one of her cord circuits in the act of answering a call, her telephone is automatically disconnected from the incoming orderwire conductors by the actuation of her busy indicating relay BI.

In illustrating our invention we have connected each outgoing trunk to an operator's cord circuit capable of being used for interconnecting local lines, but we also contemplate connecting the trunk circuits at their incoming ends to plug ended circuits adapted for use only in extending trunk connections.

In illustrating and describing our invention we have referred to particular arrangements, but it will be apparent that after becoming familiar with our invention one skilled in the art will readily see where changes and modifications may be made and therefore we do not desire to be limited to the system as shown and described but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described our invention, what we claim as new and desire to secure by United States Letters Patent, is:

1. A telephone system including two telephone exchanges each having telephone lines terminating at operators' positions thereat and cord circuits for interconnecting the lines, groups of outgoing trunk circuits at each exchange having outgoing terminals distributed before the operators' positions thereat, each group terminating at its incoming end at a single operator's position, an operator's telephone at each operator's position, an outgoing orderwire for each set of outgoing trunks connected to orderwire keys distributed among the operators' posi-

tions having access to the corresponding group of trunks, a busy signal for each key and an incoming orderwire for connecting the incoming ends of each group of trunks to the corresponding operator's telephone.

2. A telephone system including two telephone exchanges each having telephone lines terminating at operators' positions thereat and cord circuits for interconnecting the lines, groups of outgoing trunk circuits at each exchange having outgoing terminals distributed before the operators' positions thereat, each group terminating at its incoming end at a single operator's position, an operator's telephone at each operator's position, an outgoing orderwire for each set of outgoing trunks connected to orderwire keys distributed among the operators' positions having access to the corresponding group of trunks, a busy signal for each key, an incoming orderwire for connecting the incoming ends of each group of trunks to the corresponding operator's telephone, and means whereby when an operator actuates an orderwire key to connect her telephone with an outgoing orderwire a busy signal is operated at each other orderwire key corresponding to the used orderwire.

3. A telephone system including two telephone exchanges each having telephone lines terminating at operators' positions thereat and cord circuits for interconnecting the lines, groups of outgoing trunk circuits at each exchange having outgoing terminals distributed before the operators' positions thereat, each group terminating at its incoming end at a single operator's position, an operator's telephone at each operator's position, an outgoing orderwire for each set of outgoing trunks connected to orderwire keys distributed among the operators' positions having access to the corresponding group of trunks, a busy signal for each key, an incoming orderwire for connecting the incoming ends of each group of trunks to the corresponding operator's telephone, and means whereby when an operator has her telephone connected with one of her cord circuits in answering a call, the busy signals corresponding to the keys at the outgoing ends of the group of trunks extending to her position are operated.

4. A telephone system including two telephone exchanges each having telephone lines terminating at operators' positions thereat and cord circuits for interconnecting the lines, groups of outgoing trunk circuits at each exchange having outgoing terminals distributed before the operators' positions thereat, each group terminating at its incoming end at a single operator's position, an operator's telephone at each operator's position, an outgoing orderwire for each set of outgoing trunks connected to orderwire

keys distributed among the operators' positions having access to the corresponding group of trunks, a busy signal for each key, an incoming orderwire for connecting the incoming ends of each group of trunks to the corresponding operator's telephone, means whereby when an operator actuates an orderwire key to connect her telephone with an outgoing orderwire a busy signal is operated at each other orderwire key corresponding to the used orderwire, and means whereby when an operator has her telephone connected with one of her cord circuits in answering a call, the busy signals corresponding to the keys at the outgoing ends of the group of trunks extending to her position are operated.

5. A telephone system including telephone exchanges, telephone lines terminating at operators' positions in each of said exchanges with cord circuits for interconnecting said lines, a group of outgoing trunk circuits at one of said exchanges having outgoing terminals accessible from different operators' positions thereat, an operator's telephone at each position of said exchange, an order wire key at each position of said exchange common to the cord circuits thereat and connections controlled thereby for connecting the corresponding operator's telephone with said trunks, and an operator's telephone at the distant exchange normally in circuit relation with said trunks whereby the operators in the first exchange may communicate with the distant exchange operator over said trunks.

6. A telephone system including telephone exchanges, a plurality of operators' positions at one of said exchanges having telephone lines and cord circuits for interconnecting said lines, telephone lines terminating at an operator's position in the distant exchange, trunk circuits having outgoing ends at the first exchange connected multiply to jacks at the different operators' positions thereat and extending to incoming ends at the distant exchange adapted for connection with the telephone lines thereat, operators' telephones at the first said exchange positions, an operator's telephone at the distant exchange in circuit relation with said trunks, and means whereby any of the said operators' telephones in the first exchange may be connected with said trunks for communication with the distant operator independent of connection with the trunks at their outgoing ends by the associated cord circuits.

7. A telephone system comprising telephone exchanges, telephone lines, cord circuits at each of the exchanges, jack ended outgoing trunk circuits at each of the exchanges, operators' telephones, and electromagnetically controlled means whereby an

operator may connect her telephone to a trunk circuit extending to the desired distant exchange and communicate thereover as an orderwire prior to the connection of the cord circuit with such trunk.

8. A telephone system including telephone exchanges, trunk circuits connecting said exchanges and having incoming and outgoing ends, telephone lines and cord circuits for interconnecting said lines at each of the exchanges, operators' telephones at said exchanges for connection with the cord circuits, means for automatically connecting and disconnecting said operators' telephones and said cord circuits, and means for connecting said operators' telephones and trunks independent of connections between the trunks and cords whereby the operators may communicate with each other over said trunk circuits.

9. A telephone system including telephone lines and cord circuits for interconnecting the same, an operator's telephone for connection with the cord circuits, incoming trunk circuits at the exchange, means normally connecting said operator's telephone to the trunk circuits, and automatic means for disconnecting the operator's telephone from the trunks when connected to the cord circuits.

10. A telephone system including telephone lines and cord circuits for interconnecting the same, an operator's telephone for connection with the cord circuits, incoming trunk circuits at the exchange, outgoing trunk circuits at the exchange, means for connecting said cord circuits and trunks, and electromagnetic means for connecting and disconnecting the operator's telephone and trunks independent of connections between the trunks and cords whereby the said trunks may be used as orderwires.

11. A telephone system including telephone exchanges, telephone lines and cord circuits for interconnecting the lines at one of said exchanges, outgoing trunk circuits extending from said exchange to incoming ends at the distant exchange, telephone lines at said distant exchange adapted to be connected with by the incoming ends of said trunks, an operator's telephone at said distant exchange, means whereby an operator at the first said exchange may communicate with the distant operator over said trunks for order wire purposes prior to the connection of a cord circuit with the outgoing end of the trunks, and electromagnetic means for disconnecting the distant operator's telephone from said trunk circuits.

12. A telephone system including telephone lines and cord circuits for interconnecting the same, an operator's telephone for the cord circuits, outgoing trunk circuits for connection with the cord circuits in extend-

ing outgoing trunk connections, an orderwire key, and electromagnetic means controlled thereby for operatively connecting the operator's telephone to a plurality of said trunk circuits at one time.

13. A telephone system including telephone lines and cord circuits for interconnecting the same, an operator's telephone for the cord circuits, means for automatically connecting and disconnecting said operator's telephone and said cord circuits, a group of outgoing trunk circuits for connection with said cord circuits in extending outgoing trunk connections, an orderwire key, and circuit connections controlled by said key for operatively connecting the operator's telephone and the idle ones of said trunk circuits.

14. A telephone system including telephone lines terminating at operators' positions at the exchange, cord circuits at each of said positions for interconnecting said lines, an operator's telephone for the cord circuits of each position, outgoing trunk circuits having multiply connected terminals accessible from the different operators' positions for connection with the cord circuits in extending outgoing trunk connections, orderwire keys, and connections controlled by one of said keys for connecting one of said operators' telephones to said trunk circuits and for indicating busy to the other operators during such connection.

15. A telephone system including telephone lines terminating at operators' positions at the exchange, cord circuits at each of said positions for interconnecting said lines, an operator's telephone for the cord circuits of each position, outgoing trunk circuits having multiply connected terminals accessible from the different operators' positions for connection with the cord circuits in extending outgoing trunk connections, orderwire keys and connections controlled thereby for connecting any of the operators' telephones and trunk circuits, and signals corresponding to said keys whereby when any key is actuated to connect an operator's telephone to a trunk the signals for the keys corresponding to the trunk of the actuated key are operated to indicate the busy condition of the trunk.

16. A telephone system comprising telephone exchanges, telephone lines terminating at said exchanges, cord circuits at each of said exchanges, operators' telephones associated with said cord circuits, means for automatically connecting and disconnecting said operators' telephones and said cord circuits, trunk circuits at each of said exchanges, means whereby an operator may connect her telephone to one of said trunk circuits and communicate thereover as an orderwire prior to connection of one of said

cord circuits with such trunks, and means responsive to the connection of the operator's telephone with the trunk circuit for rendering ineffective the means for connecting and disconnecting said operator's telephone and cord circuits.

17. A telephone system including telephone exchanges, telephone lines terminating at said exchanges, cord circuits for interconnecting the said lines, trunk circuits extending between said exchanges, means for rendering certain of the trunk circuits that extend between two of said exchanges busy, and means whereby an operator may connect her telephone to the remaining idle ones of said trunk circuits and use said idle circuits as an orderwire in transmitting a message to a distant operator.

18. A telephone system comprising telephone exchanges, telephone lines and cord circuits at each of said exchanges, operators' telephones associated with said cord circuits, a group of trunk circuits extending between two of said exchanges, means for extending conversational circuits over part of said group of trunk circuits, and means whereby an operator may connect her telephone to the remaining trunk circuits of the group and communicate thereover as an orderwire.

19. A telephone system including telephone lines and cord circuits for interconnecting the same, an operator's telephone associated with said cord circuits, means for automatically connecting and disconnecting said operator's telephone and cord circuits, incoming trunk circuits at the exchange, connections normally extending between said operator's telephone and said trunk circuits, means for disconnecting the operator's telephone from said trunk circuits when connected to one of said cord circuits, and means for rendering ineffective said first means when said operator's telephone is operatively connected with an operator's telephone at a distant exchange.

20. A telephone system including telephone lines, cord circuits for interconnecting said lines, an operator's telephone for said cord circuits, outgoing trunk circuits for connecting with the cord circuits in extending outgoing trunk connections, an order wire key and circuit connections controlled thereby for operatively connecting the operator's telephone with the idle ones of said trunk circuits, and means for thereafter connecting one of said cord circuits with an assigned one of said idle trunks.

21. A telephone system including telephone lines, operators' link circuits for interconnecting said lines, an operator's telephone associated with said link circuits, means for automatically connecting and disconnecting said operator's telephone and

said link circuits, a group of outgoing trunk circuits for connection with said link circuits for extending outgoing trunk connections, an order-wire key, and circuit connections controlled by said key for operatively connecting the operator's telephone to a plurality of said trunk circuits for use as an order wire and for rendering ineffective said first connecting and disconnecting means.

22. A telephone system including telephone lines terminating at operators' positions at the exchange, cord circuits at each of said positions for interconnecting said lines, an operator's telephone associated with each group of cord circuits, outgoing trunk circuits provided with multiply connected terminals accessible from the different operators' positions, order-wire keys and connections controlled thereby for connecting any of the operators' telephones and said trunk circuits, and means for indicating at each operator's position that one of said order wire keys is in its operated position.

23. A telephone system including telephone exchanges, telephone lines terminating at said exchanges, cord circuits for interconnecting said lines, an operator's telephone, trunk circuits extending between said exchanges, means for rendering certain of the trunk circuits that extend between two of said exchanges busy, an order wire key, an electromagnet for each of said trunk lines, and means controlled by said order wire key for energizing the electromagnets associated with the remaining idle ones of said trunk circuits to connect said operator's telephone to the said idle trunk circuits.

24. A telephone system including trunk lines extending from one telephone exchange to another, an operator's telephone at said first exchange associated with said trunk lines, an operator's telephone at said second exchange associated with said trunk lines, means for making certain of said trunk lines test busy, an order wire key, and an electromagnet for each of said trunk lines controllable by said order wire key for connecting the operator's telephone at said first exchange over the remaining idle trunk circuits to the operator's telephone at said second exchange.

25. A telephone system including a plurality of trunk lines extending from one telephone exchange to another, an operator's telephone associated with said trunk lines, a relay for each trunk line for connecting said operator's telephone with its associated trunk line, an order wire key, means for making certain of said trunk lines busy, and circuits controlled by said order wire key for energizing the relays associated with idle trunk circuits to connect the operator's telephone with said idle trunk circuits.

26. A telephone system including a group  
of trunk lines extending from one telephone  
exchange to another, an operator's telephone  
associated with said trunk lines, an electro-  
magnet for each of said trunk lines for con-  
necting said operator's telephone thereto,  
and an order wire key for simultaneously  
energizing said electromagnets to connect  
said operator's telephone to said trunk lines.

Signed by us at Chicago, county of Cook, 19  
and State of Illinois, in the presence of two  
witnesses.

HIRAM D. CURRIER.  
RICHARD I. UTTER.

Witnesses:

GEORGE E. MUELLER,  
M. R. ROCHFORD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,  
Washington, D. C."