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G. R. EATON ET AL

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TELEPHONE SYSTEM

Filed Nov. 13, 1922

2 Sheets-Sheet 1

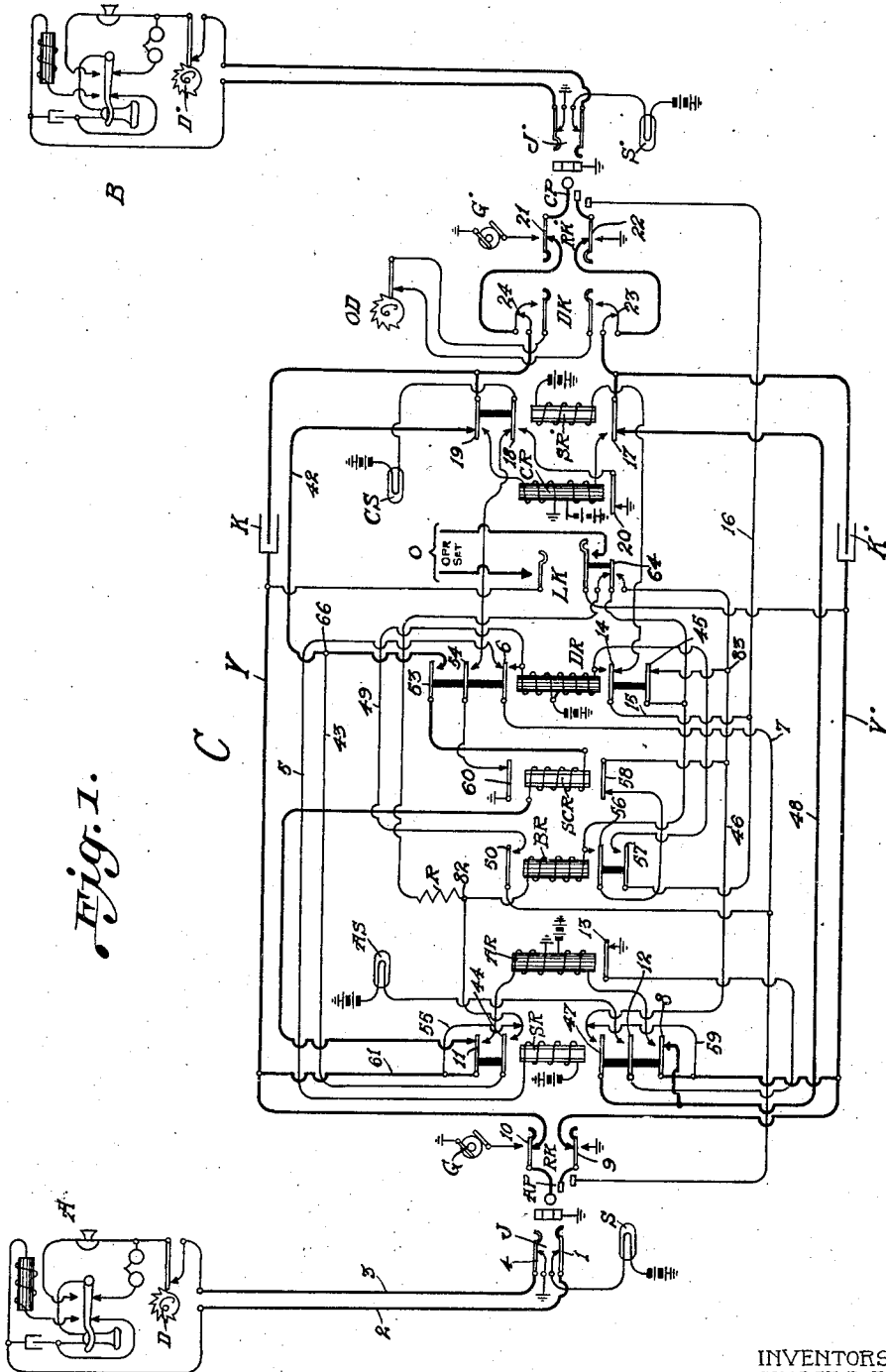


Fig. 1.

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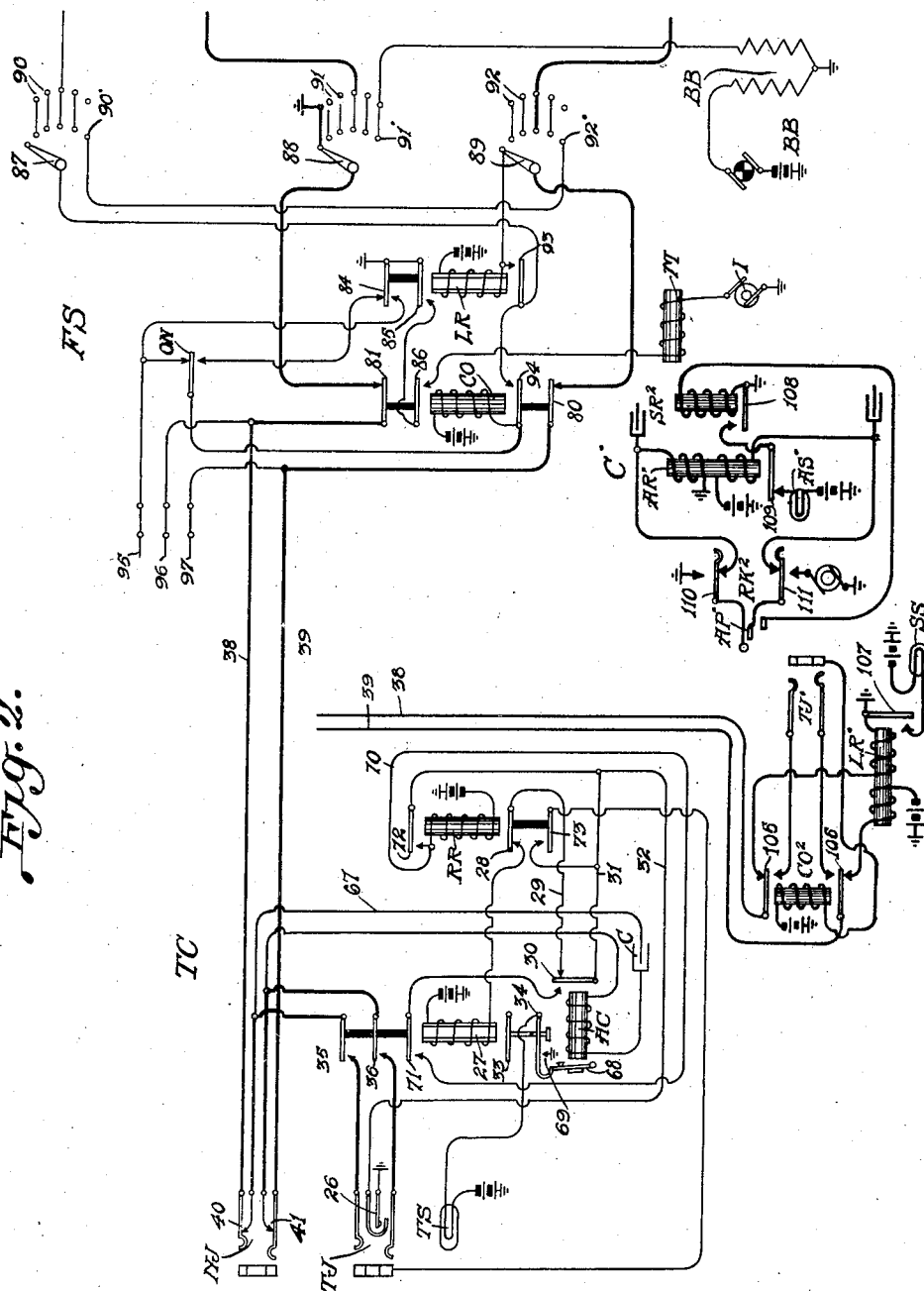
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2 Sheets-Sheet 2

Fig. 2.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed November 13, 1922. Serial No. 600,554.

Our invention relates to telephone systems, and more particularly to systems in which a number of subscribers' lines terminate in a private branch exchange and a number of other subscribers' lines terminate in a main exchange of the manual type or of the automatic type of switchboard.

An object of our invention is the provision of an operator's cord circuit at the private branch exchange for interconnecting subscribers' telephone lines terminating therein, and also the provision of a two-way trunk circuit between the private branch exchange and main exchange, the said operator's cord circuit of our invention adapted to operate in connection with said trunk circuit to interconnect a subscriber's line at the private branch exchange with a subscriber's line at the main exchange.

Another object of our invention is to provide battery for conversational purposes from the private branch exchange when our cord circuit is used for interconnecting subscribers' lines terminating in the private branch exchange, but to provide battery for conversational purposes from the main exchange, instead of the private branch exchange, when connection is made between the cord circuit at the private branch exchange and the trunk circuit of our invention.

Still another object of our invention is to place the supervisory signal at the main exchange, which notifies the operator thereof when conversation has terminated under the control of the subscriber at the private branch exchange, so that when the subscriber replaces his receiver upon its switchhook the said supervisory signal will light to indicate to the main exchange operator that the subscriber at the private branch exchange has replaced his receiver. We also place a supervisory signal at the private branch exchange under the control of the subscriber thereof so that when he replaces his receiver upon its switchhook the operator at the private branch exchange will be informed that the said subscriber has replaced his receiver at the same time the main exchange operator is notified of this fact. The features just set out above in this paragraph exist when the main exchange is a manually operated exchange, and should the main exchange be an automatic exchange, the automatic switches are placed under the control of the subscriber at the private branch exchange, as is also the said supervisory signal at the private branch exchange.

A further object of our invention is the provision of means whereby the subscriber at the private branch exchange may send a series of current impulses to operate the switches at the automatic exchange or that the operator at the private branch exchange may send a series of current impulses to operate the automatic switches at the automatic exchange instead of said subscriber.

Still another object of our invention is the provision of means whereby the private branch exchange operator may be signaled over the trunk circuit from the main exchange regardless of whether or not the said trunk circuit is engaged by a plug of a cord circuit at the private branch exchange.

The above features, as well as other features of our invention, will be more particularly pointed out in the following specification and in the appended claims.

For a more complete understanding of our invention, reference may be had to the accompanying drawings, in which

Fig. 1 illustrates the arrangement of our cord circuit, and

Fig. 2 illustrates our trunk circuit having its one end terminating in the private branch exchange in a trunk jack and night jack, and its other end terminating in an automatic switch, and also terminating in a trunk jack at a main manual exchange. In actual practice, however, it will be understood that a separate trunk circuit will extend to the automatic exchange and a separate trunk circuit will also extend to the main manual exchange.

Referring now in general to our invention, in Fig. 1 we show a substation having an impulse-sending device D and terminating in a jack J with which is operatively associated a line signal S. The cord circuit C of our invention which is provided for the private branch exchange, comprises a pair of plugs AP and CP interconnected by the talking conductors Y and Y', having the condensers K and K' interposed. In the answering end of the cord circuit C is provided a generator G and a ringback key RK and also a slow-acting sleeve relay SR, an answering supervisory relay AR and a

supervisory signal AS. The sleeve relay SR is adapted to energize when AP is connected to a jack whose sleeve contact is connected to ground, and relay SR energizing places the supervisory signal AS under the control of the answering supervisory relay AR. The calling end of cord circuit C is provided with a slow acting sleeve relay SR', a calling supervisory relay CR and a supervisory signal CS, which is placed under the control of relay CR when the sleeve relay SR' is energized. An impulse-sending device OD and a key DK are provided for connecting the said device OD in circuit with plug CP, as is also provided a ringing generator G' and a ringing key RK' for connecting said generator to the plug CP. A listening key LK is provided for connecting the operator's telephone set O to the conductors Y and Y' of cord circuit C. A slow-acting relay SCR is provided for controlling the circuit of signal CS, said signal being either under the control of a subscriber at a substation terminating in the private branch exchange or by the operator at cord circuit C. I also provide the cord circuit C with relays BR, SCR and DR which will only operate when the cord circuit C is connected to a trunk circuit, but will not operate when the cord circuit C is interconnecting subscribers' lines at the private branch exchange. To the right of Fig. 1 we show a substation B provided with an impulse-sending device D' and terminating in a jack terminal J' which has associated with it a line signal S'.

In Fig. 2 we show a trunk circuit TC terminating in a night jack NJ, which night jack NJ is used for the well-known purpose in night service, and also terminating in a trunk jack TJ which is located at the private branch exchange. Associated with the trunk jack TJ is a relay 27 which energizes when a plug of a cord circuit at the branch exchange is inserted into the jack TJ, said relay 27 controlling the lighting of the supervisory signal TS. An alternating current relay AC is provided which is controlled from the main exchange for causing the signal TS to light to signal the private branch exchange operator even though a plug of a cord circuit is engaging the jack TJ. A relay RR is also provided for controlling the circuit of relay 27 and operates when relays 27 and AC are energized. The other end of the trunk circuit TC terminates in a trunk jack TJ' at a main manual exchange, said trunk jack TJ' having a cut-off relay CO² and a line relay LR' associated therewith for controlling a supervisory signal SS. The answering end of a cord circuit C' at the main manual exchange having an answering plug AP', a ringing key RK², sleeve relay SR², supervisory relay AR' and signal AS' for the usual well-

known purposes, is shown and is adapted to be connected to the trunk jack TJ'. We also show the said other end of the trunk circuit TC terminating in a non-numerical switch FS, but this is only for the sake of explanation, for in actual practice a separate trunk circuit TC will be provided between the private branch exchange and automatic exchange, and a separate trunk circuit will also be provided between the said private branch exchange and the main manual exchange. The switch FS operates automatically, when a plug is inserted into the jack TJ, to select an idle set of contacts 90, 91 and 92 leading to an idle selector switch. The said switch comprises an off-normal contact ON, a line relay LR and a cut-off relay CO, said relays LR and CO operating, when connection is made with the trunk jack TJ, to render the said trunk switch busy against being selected when in its off-normal position, and to also close a circuit through the motor magnet M to cause the same to move the wipers 87, 88 or 89 into engagement with an idle set of contacts 90, 91 and 92 leading to an idle selector switch, and in case the switch FS is unable to select an idle selector switch, busy-back means BB are provided for notifying the calling subscriber or operator at the private branch exchange of this fact.

Having referred to our invention in general, we will now describe the same more in detail, and for a clearer understanding will first describe the manner in which a connection is established by our cord circuit between two subscribers at the private branch exchange. Assuming that the subscriber at substation A initiates a call by removing his receiver from its switchhook, the calling signal S appearing before the operator will light, over a circuit traced from battery, through the lamp S, normal contact 1 of jack J, line limb 2, through the now closed switchhook contacts of substation A, line limb 3, normal contact 4 of jack J to ground. The operator seeing the lighted lamp S will insert the answering plug AP into the jack J and then operate the listening key LK to connect her telephone set O in conversational circuit with the calling subscriber's line, and will inquire the wants of the calling subscriber at substation A. When the plug AP is inserted into the jack J, an energizing circuit is established for the slow-acting sleeve relay SR, traced from battery, through the winding of relay SR, conductor 5, normal contact 6 of relay DR, conductor 7, sleeve contacts of plug AP and jack J to ground, and relay SR energizing over this circuit, closes an energizing circuit for the answering supervisory relay AR, traced from battery, through the lower winding of relay AR, alternate contact 8 of relay SR, ring conductor of cord circuit C, normal contact

9 of ringing key RK, ring contacts of plug AP and jack J, through the alternate switchhook contacts of substation A, tip contacts of jack J and plug AP, normal contact 10 of key RK, tip conductor and alternate contact 11 of relay SR, to ground through the upper winding of relay AR. Relay SR energizing closes a circuit for the answering supervisory signal AS at its alternate contact 12, but signal AS will not light at this time due to the energization of relay AR, which opens its normal contact 13, thereby opening the circuit of signal AS to prevent the same from lighting.

15 The operator having obtained the wants of the calling subscriber will now restore her listening key LK, and assuming that the calling subscriber desires to talk with the subscriber at substation B and the substation B is idle, the operator will insert the calling plug CP into the jack J', whereupon a circuit is closed for the slow-acting sleeve relay SR', traced from battery through the winding of relay SR', normal contact 14 of relay DR, conductors 15 and 16, sleeve contacts of plug CP and jack J' to ground. Relay SR' energizing closes its alternate contacts 17, 18 and 19, which closes a circuit for the calling supervisory relay CR, but relay CR will not energize until the called subscriber responds. The calling supervisory signal CS will light over a circuit traced from battery, through the signal CS, alternate contact 18 of relay SR' to ground at normal contact 20 of relay CR, and remain lighted until the called subscriber responds to notify the operator when the called subscriber answers. The operator now operates the ringing key RK' to ring the call bell at the called substation B, and ringing current may be traced from the generator G', alternate contact 21 of ringing key RK', tip contacts of plug CP and jack J', through the call bell at substation B, ring contacts of jack J' and plug CP, alternate contact 22 to ground. When the called subscriber removes his receiver from its switchhook in response to the call bell and the key RK' is in its normal position, relay CR will energize and open its normal contact 20 in the circuit of signal CS, whereupon signal CS is effaced to notify the operator that the called party has responded and the operator will leave her ringing key RK' in its normal position. The circuit for relay CR may be traced from battery through the lower winding of relay CR, alternate contact 17 of relay SR', normal contact 23 of key DK, normal contact 22 of key RK', ring contacts of plug CP and jack J', through the now alternate contacts of the raised switchhook at substation B, tip contacts of jack J' and plug CP, normal contact 21 of key RK', normal contact 24 of key DK, alternate contact 19 of relay SR', to

ground through the upper winding of relay CR.

The subscribers at substations A and B are now in conversational circuit, which may be traced over the heavily marked conductors Y and Y' of cord circuit C. When conversation is terminated, the subscribers replace their receivers upon their respective switchhooks, and the subscriber A replacing his receiver will open the circuit of relay AR, which relay AR will de-energize and close the circuit for lamp AS, whereupon lamp AS will light to notify the operator that the calling subscriber has replaced his receiver, and when the called subscriber B replaces his receiver, the circuit of relay CR will be opened and relay CR will de-energize and close the circuit for the signal CS, causing said signal CS to light. The operator seeing the burning signals AS and CS, will know that conversation between subscribers A and B has terminated and will withdraw the plugs AP and CP from the jacks J and J', respectively, whereupon the cord circuit is restored to normal and the signals S and S' are again placed under the control of the subscribers A and B, respectively.

Having described the operation of our cord circuit C in establishing a connection between subscribers at the private branch exchange, we will now describe its operation when connection is established between a subscriber at the private branch exchange and a subscriber at a manual main exchange.

Assuming now that the subscriber at substation A initiates a call and desires to converse with a subscriber at the main exchange, the operator at cord circuit C will answer the call in the same manner as described above, and the cord circuit will operate likewise in the same manner. The operator learning that the calling subscriber desires to converse with a subscriber at the main exchange, will insert the plug CP in the trunk jack TJ, thereby closing normally open contact 26 of jack TJ by means of the plug CP, which closes a circuit for the slow-acting relay 27, traced from battery, through the winding of said relay 27, normal contact 28 of relay RR, conductor 29, normal contact 30 of relay AC, conductors 31 and 32, alternate contact 26 at jack TJ, to ground. Relay 27 energizing over this circuit attracts its lower armature 33 to prevent the contact member 34 from closing a circuit for the trunk supervisory signal TS at this time, and also closes its alternate contacts 35 and 36 to extend the tip and ring conductors of the trunk circuit TC through to the main exchange where they terminate in the trunk jack TJ'. The line relay LR' in the line circuit at the main exchange will now operate over a circuit

traced from ground through the winding of the line relay LR', normal contact 105 of the cut-off relay CO², tip conductor 38 of the trunk, normal contact 40 of jack NJ, alternate contact 35 of relay 27, tip contacts of jack TJ and plug CP, normal contact 21 of key RK', normal make-before-break contact 24 of key DK, normal contact 19 of relay SR' (the said relay SR' does not energize when the plug CP is connected to a trunk jack, as the sleeve of the jack TJ is free from ground and relay SR' failing to energize relay CR is prevented from energizing,) conductors 42 and 43, alternate make-before-break contact 44 of relay SR, winding of relay BR, normal contact 45 of relay DR, conductor 46, alternate make-before-break contact 47 of relay SR, conductor 48, normal contact 17 of relay SR', normal make-before-break contact 23 of key DK, normal contact 22 of key RK', ring contacts of plug CP and trunk jack TJ, alternate contact 36 of relay 27, normal contact 41 of jack NJ, ring conductor 39, normal contact 106 of relay CO², and to battery through the other winding of the line relay LR' at the main exchange. The line relay LR' operating closes a circuit for the supervisory signal SS to denote to the main exchange operator that a call is awaiting her attention on the trunk line, said circuit being traced from battery through the signal SS, alternate contact 107 of relay LR' to ground. Relay BR will not energize over the circuit just traced due to the high resistance of the line relay LR', at the main exchange, and also due to the shunt circuit about relay BR which may be traced from point 82 in the above traced circuit, through resistance R, normal contact 64 of key LK, normal contact 45 of relay DR and to point 83. The operator at the main exchange noting the burning supervisory signal SS before her will insert the answering plug AP' of a cord circuit C' provided for her, into the outgoing trunk jack TJ' to answer the call, and upon the insertion of said answering plug AP' into said outgoing trunk jack TJ', the sleeve relay SR² will operate and close its alternate contact 108, and the cut-off relay CO² associated therewith will operate to cause the line relay LR' to de-energize to efface the said burning signal SS in the well-known manner. The battery is now fed through the relay BR of cord circuit C, from the main exchange, through the windings of the supervisory relay AR' in the cord circuit at the main exchange, said windings being of such resistance to permit the energization of relay BR, the circuit of relay BR being the same as traced above except as to the circuit at the main exchange, which will now be through the winding of relay AR' instead of relay LR', and a further description of this is not deemed necessary. Relay AR' energizing opens its normal contact 109 to prevent the premature lighting of lamp AS'. Relay BR energizing closes a circuit for the relay DR, traced from battery through the upper winding of relay DR, conductor 49, alternate contact 50 of relay BR, sleeve contacts of plug AP and jack J to ground, and relay DR energizing closes a locking circuit for itself traced from battery through its upper winding and alternate contact 6, conductor 7, and to ground through the sleeve contacts of plug AP and jack J. Relay DR energizing opens the energizing circuit of relay SR at normal contact 6 of relay DR, and relay SR de-energizing opens its alternate contacts 11 and 12, which causes relay AR to de-energize, and said relay SR de-energizing also closes a circuit for the supervisory control relay SCR, said circuit traced from ground at the main exchange through the winding of the supervisory relay AR', the tip conductor 38 of the trunk circuit, normal contact 40 of jack NJ, alternate contact 35 of relay 27, tip contacts of trunk jack TJ and plug CP, normal contact 21 of key RK', normal contact 24 of key DK, normal contact 19 of relay SR', alternate contact 53 of relay DR, winding of relay SCR, normal contact 11 of relay SR, conductor 55, normal make-before-break contact 44 of relay SR, winding of relay BR, alternate contact 56 of relay BR, normal contact 58 of relay SCR, conductor 46, normal make-before-break contact 47 of relay SR, conductor 59, normal contact 8 of relay SR, conductor 48, normal contact 17 of relay SR', normal contact 23 of key DK, normal contact 22 of key RK', ring contacts of plug CP and jack TJ, alternate contact 36 of relay 27, normal contact 41 of jack NJ, ring conductor 39 to battery through the other winding of the supervisory relay AR' in the cord circuit at the main exchange. Relay SCR energizing over this circuit opens its normal contact 58, which opens the circuit of relay BR, and relay BR restores, and relay SCR also opens its normal contact 60 to prevent the lighting of the supervisory signal CL. Relay BR de-energizing opens its alternate contact 56, thereby opening the circuit of relay SCR, but relay SCR will not restore, as a circuit is closed for said relay SCR through the calling substantiation A. The circuit may be traced as above described up to and including normal contact 11, where it extends over conductor 61, normal contact 10 of key RK, tip contacts of plug AP and jack J, through the alternate switchhook contacts of substation A, ring contacts of jack J and plug AP, normal contact 9 of relay RK, normal contact 8 of relay SR, conductor 48 and over the previously traced circuit. Thus, it

is seen that the supervisory signal CS at cord circuit C and that the supervisory signal AS' in the cord circuit at the main exchange are controlled by the calling subscriber, and when the calling subscriber A replaces his receiver upon its switchhook, the lamp CS of cord circuit C and the supervisory signal at the main exchange will light to notify the respective operators that the connection is no longer desired.

The above operation takes place upon the main exchange operator inserting the answering plug AP' of the cord circuit into the outgoing trunk jack TJ' of the trunk line TC. The operator at the main exchange is now in conversational circuit with the calling subscriber at substation A, which may be traced over the heavily marked conductors, talking battery being fed from the main exchange, to the cord circuit C at the private branch exchange and calling substation A and the main exchange operator will inquire the wants of the calling subscriber at substation A, and upon learning that he desires to converse with a subscriber at the main exchange, she will establish connection with the called subscriber's line and signal him in the usual manner.

The calling subscriber and called subscriber are now in conversational circuit and after conversation has terminated the subscribers replace their receivers upon their respective switchhooks. The calling subscriber at substation A having replaced his receiver upon its switchhook, the circuit for the relay SCR in the cord circuit C is opened and the circuit for the supervisory relay AR' in the cord circuit at the main exchange is opened, whereupon said relays restore, and relay SCR restoring closes its normal contact 60, thereby closing a circuit for the supervisory signal CS, traced from battery, through the signal CS, normal contact 18 of relay SR', alternate contact 54 of relay DR, to ground at normal contact 60 of relay SCR. Said signal CS lighting over this circuit notifies the private branch exchange operator that conversation has terminated and that the calling subscriber has replaced his receiver, and she will then withdraw the plugs AP and CP from jacks J and J', respectively, whereupon the cord circuit C restores to its normal position. The supervisory relay AR' at the main exchange restoring immediately upon the subscriber at substation A replacing his receiver, closes a circuit for the supervisory signal AS', traced from battery, through said signal AS', normal contact 109 of relay AR' to ground, and the main exchange operator observing this burning signal AS', will know that the calling subscriber has replaced his receiver and will withdraw the plug of her cord circuit from the outgoing end jack

TJ' of the trunk circuit TC at the main exchange.

It sometimes occurs that the calling subscriber notifies the operator at the private branch exchange to call a subscriber at a main exchange for him and after notifying her of this desire replaces his receiver upon its switchhook, whereupon the private exchange operator will establish connection with the trunk line and main exchange operator in the same manner described above. In this instance, however, the private branch operator does not restore her listening key LK after learning the wants of the calling subscriber, but leaves it in its operated position for the purpose of preventing a false disconnect signal to be given to the main exchange operator. When the main exchange operator answers the call, a circuit is closed from ground through the winding of the supervisory relay AR' at the main exchange, tip contacts of plug AP' and jack TJ', trunk conductor 38, normal contact 40 of jack NJ, alternate contact 35 of relay 27, tip contacts of jack TJ and plug CP, normal contact 21 of key RK', normal contact 24 of key DK, normal contact 19 of relay SR', conductors 42 and 43, alternate contact 44 of relay SR, winding of relay BR, alternate contact 64 of listening key LK, conductor 46, alternate contact 47, conductor 48, normal contact 17 of relay SR', normal contact 23 of key DK, normal contact 22 of key RK', ring contacts of plug CP and jack TJ, alternate contact 36 of relay 27, normal contact 41 of jack NJ, conductor 39, ring contacts of jack TJ' and plug AP', to battery through the other winding of the said supervisory relay AR' at the main exchange. The supervisory relay at the main exchange operates over this circuit to prevent the lighting of the supervisory signal AS' at the said main exchange, and relay BR operating over this circuit closes an energizing circuit for relay DR, and relay DR energizing closes a locking circuit for itself, said energizing circuit and locking circuit being the same as hereinbefore traced. Relay DR energizing opens the circuit of relay SR, whereupon relay SR restores as described above, but relay BR will not restore when relay DR energizes, due to the fact that make-before-break contacts 44 and 47 do not leave their alternate position until after normal contacts 11 and 8 of relay SR are closed, whereby an operating circuit is maintained for the relay BR, said circuit being the same as described above up to point 66 between conductors 42 and 43, the circuit from this point being through alternate contact 53 of relay DR, winding of relay SCR, normal contact 11 of relay SR, conductor 46, normal contact 44 of relay SR, winding of relay BR, alternate contact 64

of listening key LK, conductor 46, normal contact 47 of relay SR, conductor 59, normal contact 8 of relay SR, conductor 48, and the remainder of the circuit is the same as traced above. Relay SCR operates over this circuit and opens its normal contacts 58 and 60, and the opening of contact 60 prevents the burning of the supervisory signal CS. The operator at the main exchange now converses with the private exchange operator and upon being informed that connection is desired with a subscriber at the main exchange, the main exchange operator will make connection with the called-for subscriber's line in the usual way, and when the called-for subscriber responds the private exchange operator will request him to wait a moment until she rings the calling subscriber at substation A, which she does by operating the ring back key RK, which connects the ringing generator G to the calling line to ring the call bell at the substation A. The calling subscriber at substation A will now respond to his call bell by removing his receiver whereupon he will be in conversational circuit with the called-for subscriber at the main exchange. The private exchange operator upon hearing the calling subscriber talk will restore her listening key LK which opens its alternate contact 64, thereby opening the circuit of relay BR, and the normal contact 58 of relay SCR being open, relay BR will restore, but relay SCR will not restore since a circuit is now closed through the alternate closed contacts of the switchhook at substation A and is held energized over the same circuit as hereinbefore traced. When conversation has terminated and the subscribers hang up their receivers, the supervisory signal CS at the private branch exchange and the supervisory signal AS' at the main exchange will light to notify the respective operators that conversation has terminated, whereupon the operators will take down the connection and the system will restore to normal in the same manner as pointed out above.

Assuming now that conversation has terminated and that the subscribers have replaced their receivers and that the private branch exchange operator fails to withdraw the plug CP from the trunk jack TJ and that the main exchange operator desires to use this trunk to signal the private branch exchange operator, she may do so even through the plug CP remains in the trunk jack TJ, and the manner in which it may be done will now be described.

The main exchange operator will operate the ringing key RK², which will open normal contacts 110 and 111 and close alternate contacts 110 and 111 to connect ringing current to the tip and ring contacts of plug AP' to bring about the operation of relay AC at the private branch exchange, over a

circuit traced from ground at the ringing key RK², through the tip contacts of plug AP' and outgoing trunk jack TJ', conductor 38, normal contact 40 of jack NJ, conductor 67, condenser C, through the winding of alternating current relay AC, normal contact 41 of jack NJ, conductor 39, ring contacts of jack TJ' and plug AP' through ringing key RK² to ringing generator and to ground. Relay AC operates over this circuit and attracts its armature 68 to permit the contact member 34 to engage the ground contact 69 when relay 27 restores, said relay AC also closes its alternate contact 30, which closes a circuit for relay RR, traced from battery through the winding of relay RR, conductor 70, alternate contact 71 of relay 27, which relay 27 is energized since the plug CP is still in the jack TJ, alternate contact 30 of relay AC, conductors 31 and 32 to ground at alternate contact 26 of jack TJ. Relay RR energizing closes a locking circuit for itself, through its alternate contact 72, conductor 32 and to ground at alternate contact 26 of jack TJ, and also opens the circuit of relay 27 at normal contact 28 of the said relay RR. Relay 27 now restores to permit the contact member 34 to engage the ground contact 69 to bring about the lighting of the trunk signal TS before the private branch exchange operator, over a circuit traced from battery through the lamp TS and to ground through the now closed contact member 34 and contact 69. The private branch operator observing the lighted lamp TS will withdraw the plug CP from the jack TJ, which permits the spring contact 26 to restore, thereby opening the locking circuit of relay RR, which will now restore, and then insert the answering plug AP and throw her listening key LK to enable her to converse with the main exchange operator, the talking battery being provided over the trunk circuit from the main exchange. When the plug AP was inserted into the trunk jack TJ a circuit was closed for relay 27, which relay 27 energizes to efface the signal TS as described in the foregoing specification, and a circuit is also closed for relay BR, traced from ground through the winding of the supervisory relay AR', in the cord circuit at the main exchange, conductor 38, normal contact 40 and alternate contact 35, tip contacts of jack TJ and plug AP, normal contact 10, normal contact 44 of relay SR, winding of relay BR, normal contact 45 of relay DR, normal contact 47 of relay SR, normal contact 9, ring contacts of plug AP and jack TJ, alternate contact 36, normal contact 41, conductor 39 and through the winding of the said supervisory relay at the main exchange to battery. The supervisory relay AR' at the main exchange energizes over this circuit to prevent the premature lighting of the supervisory signal AS' thereat, as before de-

scribed, and relay BR energizing over this circuit closes a locking circuit for itself, through its alternate contact 56, normal contact 58 of relay SCR and over the previously described circuit. The operator upon learning that the subscriber at substation A is wanted, which we will assume will be the subscriber wanted by the main exchange operator, will insert the calling plug CP into the jack J, thereby closing a circuit for relay DR, traced from battery, through the lower winding of relay DR, alternate contact 57 of relay BR, conductor 16, to ground through the sleeve contacts of plug CP and jack J, and relay DR energizing closes a locking circuit for itself through its alternate contact 14 and conductor 16 to ground at jack J. Relay DR energizes upon the insertion of the plug CP into the jack J before relay SR' has time to energize, and relay DR energizing opens its normal contact 14 which prevents relay SR' from energizing. Relay SCR does not operate at this time. The operator now operates the ringing key RK' to apply ringing current to the call bell of the substation A and the subscriber in response to his call bell will remove his receiver from its switchhook, thereby closing a circuit for relay SCR traced over the same circuit as that of relay BR up to normal contact 11 of relay SR, where battery now flows through the winding of relay SCR, alternate contact 53 of relay DR, normal contact 19 of relay SR', normal contacts 24 and 21, tip contacts of plug CP and jack J, through the alternate switchhook contacts of substation A, ring contacts of jack J and plug CP, normal contacts 22 and 23, normal contact 17 of relay SR', conductor 48, normal contact 8 of relay SR' and over the previously traced circuit of relay BR. Relay SCR operating opens its normal contact 58, thereby opening the holding circuit of relay BR, and relay BR restores if the operator has restored her ringing key RK, but the supervisory relay at the main exchange is held energized now in circuit with the relay SCR. During the time the operator is ringing the called-for subscriber at substation A, the supervisory signal CS will burn and when the key RK' is restored and should the subscriber respond during this period, relay SCR will energize as just pointed out above, and will open its normal contact 60, whereby the signal CS is effaced, which will notify the operator that the subscriber has responded.

The subscriber at substation A and the operator at the main exchange are now in conversational circuit, talking battery being fed from the main exchange over the heavily marked conductors, and when conversation has terminated the subscriber at substation A replacing his receiver will open the circuit of the relay SCR in the cord circuit C

and of the supervisory relay AR' at the main exchange, thereby causing the lamp CS to light to notify the operator at cord circuit C that conversation has terminated and the operator at cord circuit C will take down the connection, and after conversation has terminated the main exchange operator will withdraw the plug AP' from the jack TJ', whereupon the system restores to normal as described above. Should a subscriber at the main exchange desire to talk with the subscriber at substation A at the private branch exchange the main exchange operator will insert the calling end of her cord circuit C' (not shown on the drawing, as it is not deemed necessary for a clear understanding) into the jack TJ' and apply ringing current to operate relay AC to bring about the lighting of signal TS as pointed out above. In this instance the relays SCR and BR will be energized by battery provided through the supervisory relay in the calling end of the cord circuit C, and when the subscriber at substation A replaces his receiver, the supervisory signal controlled by said relay in the said calling end will light to notify the main exchange operator that conversation has terminated, whereupon she will take down the connection, and the operator at cord circuit will be notified of the termination of conversation as pointed out above.

From the above description of our invention, it is at once clear that the main exchange operator may use the trunk circuit to signal the operator at the private branch exchange, even though the plug of the cord circuit C remains in the trunk jack TJ, and further that the operator at cord circuit C and the operator at the main exchange will be notified that conversation has terminated immediately upon the subscriber at substation A replacing his receiver upon its switchhook.

A description of the operation of my invention will now be given when used to connect a calling subscriber at the private branch exchange with a called-for subscriber at an automatic exchange.

Assuming that the calling subscriber at the substation A of the private branch exchange initiates a call, the private branch exchange operator will answer the call in the same manner described in the foregoing specification, and upon learning that the calling subscriber desires to converse with a subscriber whose line terminates in an automatic exchange, she will insert the calling plug CP of the cord circuit C into the trunk jack TJ, it being assumed now that the trunk circuit TC terminates in an automatic exchange instead of a manual main exchange as described above, whereupon relay 27 will energize to prevent the lighting of the supervisory lamp TS, as was clearly pointed out

above. Relay 27 energizing closes its alternate contacts 35 and 36 to extend the trunk conductors to the automatic switch FS, which operates to select an idle first selector switch. The line switch LS and the automatic switches used at the automatic exchange may be the same as those described and shown in the Winston Patent No. 1,197,989, patented September 12, 1916, reference being had to this patent for a clearer understanding of the operation of the switches which may not be understood from the ensuing specification. When the alternate contacts 35 and 36 of relay 27 are closed a circuit is established from battery through the winding of relay LR, wiper 89, normal contact 80 of relay CO, conductor 39, normal contact 41 of jack NJ, alternate contact 36 of relay 27, ring contacts of jack TJ and plug CP, normal contacts 22 and 23, normal contact 17 of relay SR', conductor 48, alternate contact 47 of relay SR, conductor 46, normal contact 45 of relay DR, through the winding of relay BR, alternate contact 44 of relay SR, normal contact 19 of relay SR', normal contacts 24 and 21, tip contacts of plug CP and jack TJ, alternate contact 35 of relay 27, normal contact 40 of jack NJ, conductor 38, normal contact 81 of relay CO, wiper 88 and to ground. Relay LR energizes over this circuit but relay BR does not energize over this circuit due to the high resistance of relay LR compared with that of relay BR, and also due to the shunt circuit about relay BR which may be traced from the point 82 in said circuit, through resistance R, normal contact 64 of listening key LK to point 83, and relay LR energizing closes its alternate contact 84 to place a ground upon the conductor 95 to render the switch FS busy to prevent the switch FS from being selected while busy, and also to establish an energizing circuit for cut-off relay CO through normal contact ON. Relays LR and CO being energized a circuit for motor magnet M is established through their alternate contacts 85 and 86, respectively, whereby said magnet M advances wipers 87, 88 and 89 into engagement with the first set of contacts 90, 91 and 92, which we will assume, leads to a busy first selector switch. Therefore, the test contact 90 thereof is grounded due to the busy condition of the first selector switch, which may be more clearly understood by referring to the Winston Patent No. 1,197,989, referred to above, and a locking circuit for relay LR and CO is, therefore, established, which may be traced from ground at the test contact 90, test wiper 87, and alternate contacts 93 and 94 and the windings of relay LR and CO, respectively. Relay CO thus maintains the circuit of driving magnet M closed, notwithstanding the opening of the circuit at off-normal contacts ON at the first step of the

switch. Magnet M now advances the wipers another step and in fact continues such advancement until the test wiper 87 engages an idle test contact 90, which, we will assume, is the third one leading to a first selector switch. Assuming this is idle, as stated, it would be ungrounded and therefore the locking circuit for relays LR and CO is interrupted, but relay LR being a slow-acting relay maintains its armature attracted until a locking circuit from the selected first selector switch is provided, in the manner well-known in the art, but relay CO being a quick-acting relay immediately releases its armature, opening its contact 86 in the circuit of driving magnet M, thus rendering the switch wipers inert, thereby permitting them to remain in engagement with the contacts of the idle selector switch. When an idle selector switch is selected, battery will be fed through the windings of an impulse relay in the selector switch to the contacts 91 and 92 engaged by the wipers 88 and 89, respectively, in the well-known manner, the windings of said impulse relay being of such resistance as to permit the energization of the relay BR over the previously traced circuit, and relay BR energizing a circuit will be established for relay DR, traced from battery through the upper winding of said relay DR, conductor 49, alternate contact 50 of relay BR to ground through the sleeve contacts of plug AP and jack J. Relay DR energizing over this circuit will lock up through its alternate contact 6, conductor 7 and to ground at the sleeve of jack J, and relay DR also opens the energizing circuit of relay BR at normal contact 45 and closes a circuit for relay SCR, said circuit being traced from the tip contacts of the jack TJ and plug CP, which battery extends to said jack TJ from the wiper 88, through the normal contacts 21, 24 and 19, alternate contact 53 of relay DR, winding of relay SCR, normal contact 11 of relay SR, said relay SR having restored when relay DR energized, normal contact 10, tip contacts of plug AP and jack J, through the now closed alternate contacts of the switch-hook at substation A, ring contacts of jack J and plug AP, normal contact 9, normal contact 8 of relay SR, conductor 48, normal contact 17 of relay SR', normal contacts 23 and 22, ring contacts of plug CP and jack TJ, and to the other side of battery through wiper 89. Relay SCR energizing over this circuit opens its normal contact 58, thereby opening the holding circuit of relay BR, thus causing relay BR to restore, and relay SCR also opens its normal contact 60, which opens the circuit of the supervisory signal CS to prevent the same from lighting at this time.

The operation of the finder switch FS and the cord circuit C as just described above

occurs immediately upon the insertion of the plug CP into the jack TJ and before the calling subscriber has time to operate his impulse dial D. The calling subscriber at substation A now operates his dial to send impulses to operate the automatic switches at the main exchange in the usual well-known manner. The circuit for the impulses being from the wiper 88, normal contacts 81 and 40, alternate contact 35 of relay 27, tip contacts of jack TJ and plug CP, normal contacts 21, 24 and 19, conductor 42, normal contact 53 of relay DR, through the winding of relay SCR, normal contact 11 of relay SR, normal contact 10 of key RK, tip contacts of plug AP and jack J, normal contact spring of the impulse dial D, alternate switchhook contacts of substation A, ring contacts of jack J and plug AP, normal contact 9 of key RK, normal contact 8 of relay SR, conductor 43, normal contact 17 of relay SR, normal contacts 23 and 22, ring contacts of plug CP and jack TJ, alternate contact 36 of relay 27, normal contacts 41 and 80 and to the wiper 89. When the dial is operated this circuit will be opened and closed, as is well known, but relay SCR being slow-acting will not de-energize, as the circuit is opened and closed at such rapidity that the circuit will not be opened sufficiently long to cause the de-energization of relay SCR, thus preventing the premature lighting of the signal CS. After the sending of the impulses and the called subscriber responds, it being assumed that the called subscriber's line was idle when called, the calling subscriber at substation A and the called subscriber at the automatic exchange are in conversational circuit, traced over the heavily marked conductors having the condensers K and K' interposed, talking battery being fed from the automatic exchange.

After conversation has terminated, the subscribers replace their receivers upon their respective switchhooks, and the replacing of the receiver upon its switchhook at the substation A will open the circuit of relay SCR at the alternate switchhook contacts of substation A, whereupon relay SCR will restore and close its normal contact 60, thereby closing a circuit for the signal CS, traced from battery through the lamp CS, alternate contact 18 of relay SR, alternate contact 54 of relay DR to ground through normal contact 60 of said relay SCR. When the subscriber at substation A replaces his receiver, the holding circuit for the automatic switches at the automatic exchange was opened, whereupon said switches restore in the usual and well-known manner. The private branch exchange operator seeing the burning signal CS will know that the conversation has terminated and that the calling subscriber has replaced his receiver upon its switchhook, and she will withdraw the plugs

AP and CP from the jacks J and TJ, respectively, whereupon relay DR restores and the signal CS is effaced and the cord circuit C is restored to normal. Upon the removal of the plug CP from the jack TJ, relay 27 restores as described in the foregoing specification. Now, as to the restoration of the switch FS, this is effected upon the restoration of the selector switch selected by said switch FS, which opens the holding circuit of relay LR and causes relay LR to restore. Relay LR restoring, its normal contact 84 is closed, connecting ground through alternate contact ON and the winding of relay CO to battery. Thus, relay LR being de-energized and relay CO energized, the retaining pawls controlled by these relays are disengaged from their associated ratchet, allowing the switch FS to restore. The restoration of the switch FS and the other switches at the automatic exchange may be understood more clearly by referring to the Winston patent mentioned above.

Reverting now to when the operator at cord circuit C answered the calling subscriber at substation A, and assuming that the calling subscriber thereat requested the operator to call the subscriber at the automatic exchange and to call him back when the called-for subscriber answers, the calling subscriber in this instance will replace his receiver, after informing the operator of his wants, and await a call from the operator at cord circuit C. The operator will not restore her listening key at this time but will leave it in its operated position to close its alternate contact 64 to close a circuit for the relay BR as hereinbefore described. The operator will now insert the calling plug CP into the jack TJ, whereupon an idle selector switch is selected by the switch FS in the same manner pointed out above, and when an idle selector switch is selected an energizing circuit is closed for relay BR, as hereinbefore traced, and relay BR energizing closes a circuit to bring about the energization of relay DR, and relay DR energizing causes the restoration of relay SR as clearly pointed out above, and also the energization of relay SCR, the circuit for relay SCR being the same as traced above up to normal contact 11 where it now extends through normal contact 44 of relay SR, winding of relay BR, alternate contact 64 of key LK, conductor 46, normal contact 8 of relay SR and over the previously traced circuit. Relay SCR energizing opens its contact 58 in the holding circuit of relay BR, but relay BR does not restore since the listening key LK is thrown and its alternate contact 64 is closed to establish a holding circuit for relay BR. Relay SCR energizing also prevents the signal CS from lighting at this time. The operator now operates her dialing key DK, thereby opening the

circuit of relays BR and SCR, causing the same to restore, but whose restoration has no particular effect at this time, said key DK connecting the operator's impulse-sending device OD in circuit with the trunk conductors leading to the automatic switches in the automatic exchange. The operator will now operate the impulse dial OD to bring about the operation of the automatic switches at the automatic exchange to cause the same to connect to the called-for subscriber's line, and having sent the required number of impulses, she will restore her dialing key DK, whereupon relays BR and SCR will again energize, and upon hearing the response of the called-for subscriber, will inform him to wait until she rings the calling subscriber at substation A, which she will do by operating her ringback key RK, as hereinbefore described, and upon hearing the calling subscriber answer she will restore her listening key LK. The calling and called subscriber are now in conversational circuit. When the listening key LK is restored relay BR de-energizes due to its circuit being opened at alternate contact 64 of said key LK, but relay SCR will not de-energize as it will now be held up over a circuit extending through the now closed alternate switchhook contacts at substation A, and signal CS will not light, as pointed out above.

When the conversation has terminated and the subscribers replace their receivers, the holding circuit for the automatic switches will be opened to permit the same to restore and relay SCR will restore and the signal CS of cord circuit C will light to denote that the calling subscriber has replaced his receiver and the operator seeing this light will withdraw the plugs AP and CP, which will bring about the restoration of the system as set out above.

In connection with the finder switch FS, means are provided to indicate to the calling subscriber or the private branch operator at cord circuit C when such switch has not been able to find an idle trunk. For instance, if all of the trunks leading from contacts 90, 91 and 92 are busy, their test contacts 90 will be grounded, causing the switch to step to the last set of contacts 90', 91' and 92'. There being no ground connected to terminal 90', relay CO immediately de-energizes but relay LR maintains its armature attracted due to its slow-acting construction, so that upon the closing of normal contacts 80 and 81 of relay CO, a locking circuit LR is established from ground through busy-back BB, terminal 91', wiper 88, normal contact 81 of relay CO, over the trunk conductor 38 to the calling substation A, if subscriber thereat has not replaced his receiver, or through the listening key LK and the

operator's telephone set, if she has the key LK in its operated position, returning over the trunk conductor 39, normal contact 80, relay CO, wiper 89, contacts 92' and 90', wiper 87, alternate contact 93 of relay LR to battery. A characteristic signal is thus transmitted from busy-back signal BB over the path just described, whereby the subscriber at A or the operator at cord circuit C receiving such signal knows that all of the trunks are busy and if received by the calling subscriber he will replace his receiver, whereupon lamp AS will light to give an indication to the operator at cord circuit C, and the operator seeing the burning lamp AS will withdraw the plug AP and CP from jacks J and TJ. The lamp AS lights when the subscriber at A replaces his receiver due to the fact that relay SR remains energized since no idle selector switch was selected and relay AR will restore, thereby closing an operating circuit for said signal AS. If the operator at cord circuit C receives the signal due to the fact that she has her listening key operated when she is requested by the calling subscriber to call the called-for subscriber, she will recognize the busy condition and withdraw the plugs AP and CP, whereupon the switch FS will restore to normal in the same manner described above.

Assuming now that a subscriber terminating in the automatic exchange desires to signal the private branch exchange operator at cord circuit C, and that the plug CP of cord circuit C is still engaging the trunk jack TJ, which maintains the circuit of relay 27 closed, and that the switch FS is in its normal position, the said subscriber will operate his impulse sending device to cause a connector switch to engage contacts connected to the conductors 95, 96 and 97, whereupon an alternating current will be sent from the connector switch over conductor 96, normal contact 40 of jack NJ, conductor 67, condenser C, winding of relay AC, normal contact 41 of jack NJ, conductors 39 and 97 to the connector switch at the automatic exchange. The relay AC operates over this circuit and the relay 27 being energized due to the fact that plug CP is in jack TJ, a circuit is closed through relay RR, which energizes and closes a locking circuit for itself, said relay RR energizing opens the circuit of relay 27 which will now restore to permit the lamp TS to light as hereinbefore clearly set out. The operator seeing the lighted lamp TS will take care of the call by removing the plug CP and inserting the answering plug AP into the jack TJ and will then extend the call as before described. Thus, it will be understood that the fact that the plug remains in the jack TJ after the conversation has termi-

nated, does not prevent the trunk circuit TC from being used to signal the private branch exchange operator at cord circuit C.

While we have illustrated and described a particular arrangement of our invention, it is to be understood that we do not wish to be limited to the exact arrangement as shown and described, as modifications and changes will suggest themselves to those skilled in the art, but we intend 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 Letters Patent is:

1. In a telephone system including a private branch exchange, subscribers' telephone lines terminating therein, a link circuit for interconnecting said telephone lines in conversational circuit, a main exchange, a trunk circuit between said private branch exchange and said main exchange, said link circuit adapted to be connected to said trunk circuit to connect a subscriber's line at the branch exchange with the main exchange, individual supervisory means at the main exchange and at the private branch exchange controlled over the said subscriber's telephone line on either incoming or outgoing calls, to notify the operators at the private branch exchange and main exchange respectively when conversation has terminated, means whereby the subscriber on said telephone line may communicate his wants to the operator at the main exchange, or whereby the operator at said branch exchange may communicate said subscriber's wants to the main exchange operator, means operative when said branch exchange operator communicates the subscriber's wants to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, means for providing battery for talking purposes from the main exchange, and means for said trunk circuit to permit signalling of the branch exchange operator should said link circuit remain connected to said trunk circuit.

2. In a telephone system including a private branch exchange and a main exchange, telephone lines terminating in said private branch exchange, a trunk circuit between said exchanges, a link circuit for interconnecting said telephone lines and for connecting one of said telephone lines in circuit with said main exchange over said trunk circuit, supervisory means at the main exchange and at the private branch exchange controlled over said telephone line connected in circuit with said main exchange to indicate to the operator at said main exchange and said private branch exchange when con-

nection is no longer desired with said main exchange on either incoming or outgoing calls, means whereby the subscriber on said telephone line may communicate his wants to the operator at the main exchange, or whereby the operator at said branch exchange may communicate said subscriber's wants to the main exchange operator, means operative when said branch exchange operator communicates the subscriber's wants to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, and means for said trunk circuit for signaling the private branch exchange operator over said trunk circuit regardless of whether or not the said link circuit is connected to said trunk circuit.

3. In a telephone system including a private branch exchange having subscribers' telephone lines terminating therein, a link circuit for interconnecting said lines, a main exchange, a trunk circuit terminating in said private branch exchange and said main exchange, said link circuit adapted to be connected to said trunk circuit to connect a subscriber on one of said telephone lines in conversational circuit with said main exchange, supervisory means for said main exchange and said private branch exchange controlled over the subscriber's line which is in conversational circuit with the main exchange to notify the private branch exchange operator and main exchange operator when the conversational circuit is no longer desired on either incoming or outgoing calls, means whereby the subscriber on said telephone line may communicate his wants to the operator at the main exchange, or whereby the operator at said branch exchange may communicate said subscriber's wants to the main exchange operator, means operative when said branch exchange operator communicates the subscriber's wants to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, means for providing talking battery from the main exchange, and automatic means for said trunk circuit for signaling the private branch exchange operator even though said cord circuit remains connected to said trunk circuit.

4. In a telephone system including a main exchange, a private branch exchange having subscribers' telephone lines terminating therein, a trunk circuit terminating in said private branch exchange and said main exchange, a link circuit at the private branch exchange for connecting one of said sub-

scribers' lines in circuit with said main exchange over said trunk circuit, individual supervisory means for said private branch exchange and said main exchange, and means controlled by the subscriber at the private branch exchange for controlling said individual supervisory means on either incoming or outgoing calls for signalling for a disconnection at both exchanges, means whereby the subscriber on said telephone line may communicate his wants to the operator at the main exchange, or whereby the operator at said branch exchange may communicate said subscriber's wants to the main exchange operator, means operative when said branch exchange operator communicates the subscriber's wants to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, and means for said trunk circuit to permit the signalling of the private branch exchange should said link circuit remain connected to said trunk circuit.

5. In a telephone system including a private branch exchange and a main exchange, a trunk circuit terminating in said branch exchange and said main exchange, a subscriber's telephone line terminating in said branch exchange, a cord circuit for connecting said telephone line to said trunk circuit, individual supervisory signalling means for said main exchange and said private branch exchange, said means controlled by the subscriber at said private branch exchange on either incoming or outgoing calls for indicating termination of conversation at both exchanges, means whereby the subscriber at said private branch exchange may communicate his wants to the operator at the main exchange, or whereby the operator at said branch exchange may communicate the said subscriber's wants to the main exchange operator, means operative when said branch exchange operator communicates the subscriber's wants to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, and means for said trunk circuit for permitting the operator at said cord circuit to be signalled from said main exchange regardless of whether or not said cord-circuit is connected to said trunk circuit.

6. In a telephone system including a private branch exchange having subscribers' telephone lines terminating therein, a main exchange, a trunk circuit between said private branch exchange and said main ex-

change, a cord circuit for interconnecting said telephone lines and also for connecting any one of said lines to said trunk circuit, means for providing talking battery from said main exchange, supervisory means for said cord circuit for indicating to the operator thereat when the subscriber has terminated conversation, supervisory means at said main exchange for indicating when said conversation has terminated, both of said supervisory means being controlled by the subscriber at the private branch exchange on either an incoming or an outgoing call, means whereby the subscriber at the private branch exchange may communicate his wants to the operator at the main exchange, or whereby the operator at the branch exchange may communicate to said subscriber's wants to the main exchange operator, means operative when said operator communicates the wants of the subscriber to the main exchange operator to prevent the said supervisory means operating to signal a false disconnection signal upon the replacement of the calling subscriber's receiver upon its switchhook while said subscriber is waiting for his call to be completed, and means for signalling the branch exchange operator from the main exchange prior to the disconnection of said cord circuit from said trunk circuit.

7. In a telephone system, a private branch exchange, a subscriber's telephone line terminating therein, a main exchange, a trunk circuit for interconnecting said exchanges, a cord circuit at the private branch exchange for connecting said telephone line to said trunk circuit, means whereby the subscriber on said telephone line may communicate his wants to the operator at the main exchange, or whereby the operator at said cord circuit may communicate said subscriber's wants to the main exchange operator, means for recalling said subscriber when the main exchange operator fulfills the wants of said subscriber, means for providing talking battery from said main exchange, and supervisory means at the main exchange and at the private branch exchange controlled over said telephone line on either incoming or outgoing calls for notifying the respective operators thereat when the subscriber on said telephone line replaces his receiver upon its switchhook and to signal for a disconnection, means for rendering said supervisory means inoperative when the subscriber replaces his receiver upon its switchhook while waiting for the operator at the private branch exchange to communicate his wants to the main exchange operator, and means for said trunk circuit to permit the signalling of the branch exchange should said link circuit remain connected to said trunk circuit.

8. In a telephone system including a pri-

5 vate branch exchange, subscribers' telephone
lines terminating therein, a cord circuit for
interconnecting said telephone lines, a main
exchange, a trunk circuit for interconnect-
10 ing said exchanges, said cord circuit adapt-
ed to be connected to said trunk circuit to
extend a call from the private branch ex-
change to the main exchange, means where-
by the subscriber at said telephone line may
15 communicate his wants to the operator at
the main exchange, or whereby the operator
at said cord circuit may communicate said
subscriber's wants to the main exchange op-
erator, means for recalling the calling sub-
20 scriber when the branch exchange operator
effects the call to the main exchange, means
for providing talking current from the main
exchange, individual supervisory means for
said private branch exchange and said main
exchange controlled by the subscriber at the

private branch exchange on either incoming
or outgoing calls for indicating to the op-
erators at said exchanges when conversation
has terminated, means operative when the
operator at the private branch exchange ef- 25
fects the subscriber's call to the main ex-
change to prevent the supervisory means op-
erating to signal a false disconnection sig-
nal when the subscriber replaces his receiver
upon its switchhook while waiting for his 30
call to be completed, and means for said
trunk circuit to permit the signalling of the
branch exchange should said link circuit re-
main connected to said trunk circuit.

Signed by us at Chicago, in the county of 35
Cook and State of Illinois, this 9th day of
November, 1922.

GEORGE R. EATON.
MICHAEL B. STAZAK.