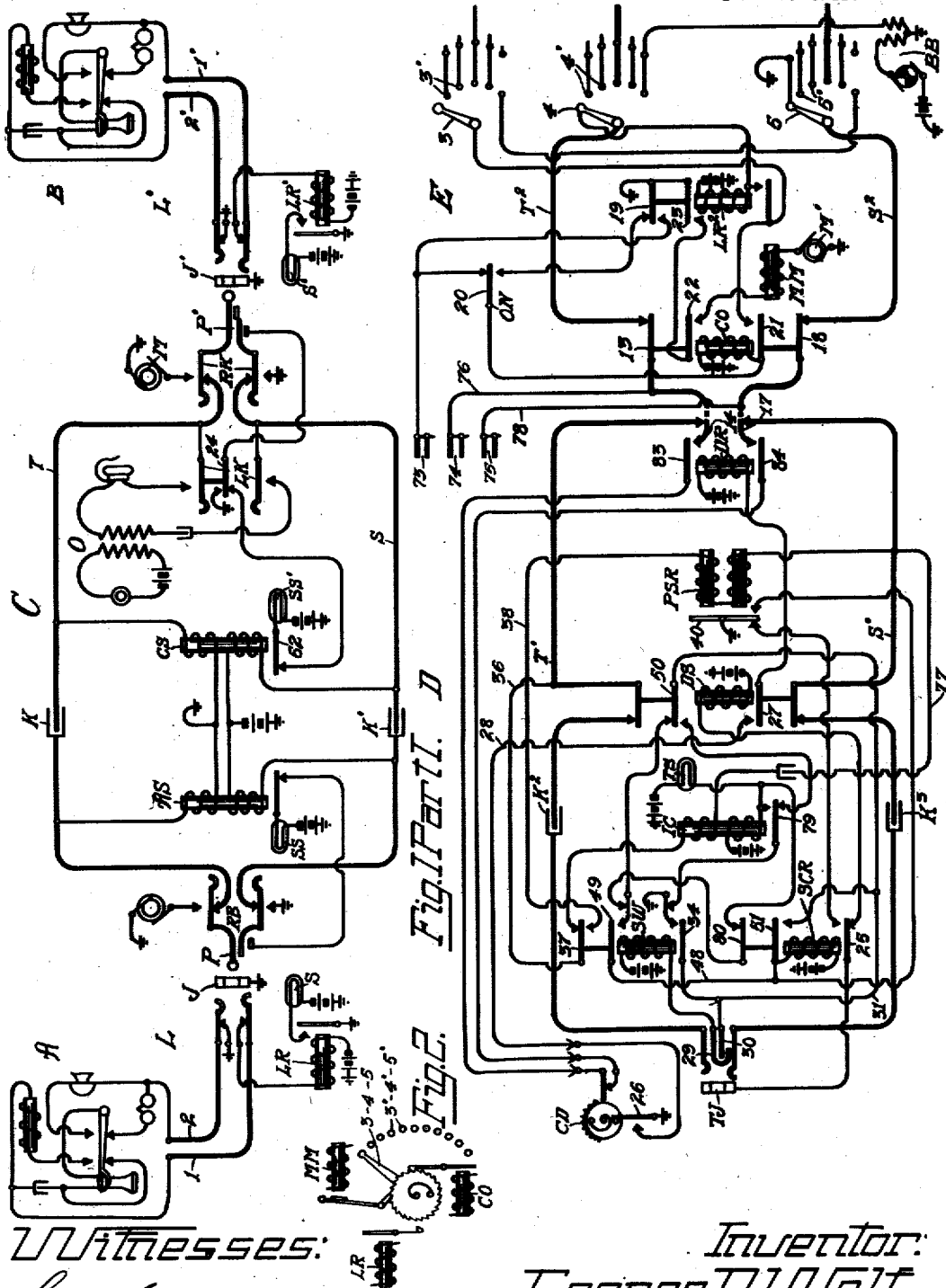


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SYSTEM FOR INTERCONNECTING MANUAL AND AUTOMATIC TELEPHONE EXCHANGES.
APPLICATION FILED SEPT. 14, 1914.

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2 SHEETS—SHEET 1.



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UNITED STATES PATENT OFFICE.

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SYSTEM FOR INTERCONNECTING MANUAL AND AUTOMATIC TELEPHONE-EXCHANGES.

1,343,489.

Specification of Letters Patent. Patented June 15, 1920.

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To all whom it may concern:

Be it known that I, GEORGE D. WOLF, residing at Chicago, county of Cook, and State of Illinois, have invented new and useful
5 Improvements in Systems for Interconnecting Manual and Automatic Telephone-Exchanges, of which the following is a specification.

My invention relates to systems for inter-
10 connecting main automatic and branch manual exchanges and is directed more particularly to such systems wherein the operator at the branch exchange actuated a calling device in extending connections from the
15 manual to the automatic substations.

In connection with the installation of automatic telephone systems, operator controlled private branch exchanges for interconnecting the branch lines are employed.
20 At the private branch exchange, operators' cord circuits are provided for interconnecting the local lines, and trunk circuits are used for interconnecting the manual and automatic exchanges. When a branch exchange substation is to be connected to an
25 automatic substation the operator connects one end of a cord circuit to the calling branch substation and then inserts the calling plug of the selected cord into a trunk
30 jack extending to the automatic exchange after which she actuates a calling device according to the number of the wanted automatic substation, to operate the automatic
35 switches to extend the call. In systems of this character the operator upon answering a call from a branch substation throws the listening key to converse with the calling
40 subscriber and one of the features of my invention resides in a control circuit affected by the thrown listening key when the calling
45 plug is inserted into a trunk jack, to operatively associate the operator's calling device therewith. In this way no extra manipulation of a key is necessary to connect the calling device.

Another feature of my invention is directed to a control circuit whereby after the call has once been extended by the use of the calling device and either the listening
50 key has been restored or the called subscriber has answered, the calling device cannot again be operatively associated with this particular trunk until the established connection has been taken down. In this way
55 I eliminate the possibility of interference

with an established connection by a subsequent incidental or intentional actuation of the calling device.

In the particular embodiment of my invention herein illustrated, I have chosen to
60 use a two-way trunk circuit but it is to be understood that my invention is not limited thereto.

For a better understanding of my invention reference is to be had to the accompanying
65 drawings in which all parts are shown at normal and like parts are indicated by like reference characters and in which—

Figure 1, part 1, illustrates a cord circuit and two line circuits of a private branch
70 exchange together with a trunk circuit extending to an individual switch capable of extending a connection to an automatic switch in the automatic exchange as shown
75 in Fig. 1, part 2, and

Fig. 2 illustrates diagrammatically the line switches E and E¹.

Referring now in general to my invention as illustrated in Fig. 1, part 1, it comprises a local calling substation A of a well-known
80 type which is connected by the line limbs 1 and 2 to a line circuit L which comprises a line relay LR, a signal S and a jack J. The private branch cord circuit C comprises an answering plug P, and a calling plug P¹
85 connected by the heavily marked conductors T and S, and having the condensers K and K¹ interposed. The answering end of the cord circuit C comprises an answering supervisory relay AS which controls the supervisory
90 signal SS and the calling end of the cord circuit C comprises a calling supervisory relay CS which controls supervisory relay SS¹. A listening key LK is provided which when thrown connects the operator's
95 set O and a ringing key RK is also shown, which when thrown connects generator M to ring the called-for substation of a local line. To the right I have shown a substation B similar to A connected by line limbs 1' and
100 2' to a line circuit L¹ similar to that shown at L.

The two-way trunk circuit D comprises a trunk jack TJ, the terminals of which
105 are connected by the heavily marked conductors T¹ and S¹ to a line switch E at the automatic exchange. A dial switching relay DS is also included, being energized when a plug of a branch exchange cord circuit is inserted into the jack TJ and the
110

listening key LK is thrown. Relay DS places the calling device CB in operative relation with the trunk circuit D so that its actuation will energize the dial connecting relay DR upon transmission of each set of impulses. A switching relay SW is associated with the trunk circuit D which disconnects the incoming call signal relay IC and places the polarized supervisory relay PSR in bridge of the trunk talking conductors. A supervisory circuit control relay SCR is also associated with the trunk circuit D and controls the supervisory circuit leading from normal contact 40 to the signal SS of the cord circuit. Relay SCR also controls the circuit of the dial switching relay.

An individual switch E is associated with each trunk circuit D and comprises a line relay LR², a cut-off relay CO and a motor magnet MM which steps the wipers 3, 4, and 5 by the aid of the generator M¹, to select an idle connector F as shown in Fig. 1, part 2. A busy back BB is shown which sends a busy signal to the calling subscriber in the event that all the connectors with which the line switch E is associated are busy.

The connector F which is of the Strowger type and illustrated in Fig. 1, part 2, comprises an interrupter relay IR, a private relay PV, a secondary relay SR, and a vertical magnet VM which is energized and deenergized by operation of the relay IR to step the wipers 6, 7 and 8 of the connector F in a vertical direction to select a group of contacts. A rotary magnet RM is provided which is energized by the last set of impulses to step the wipers 6, 7 and 8 in a horizontal direction to select the contacts of a called line in the selected group. A busy relay BR is associated with the connector to connect the busy back BB¹ in case the called line is busy. A ringing relay RI is intermittently energized and deenergized by an interrupter I, to connect the ringing generator M² to ring the called line and a ringing control relay RCR is energized when the called substation answers to disconnect the ringing generator M². A release relay RR and a release magnet REM are associated with the connector, the magnet REM being energized upon the deenergization of the relay RR to release the switch mechanism. An off-normal contact ON¹ is associated with the connector and assumes its off-normal position upon the first step of the wipers off-normal. Side switch arms 9, 10, 11 and 12 are provided and are stepped to their different positions upon each restoration of the relay PV. An automatic substation H is shown to the right of Fig. 1, part 2, being similar to that of A and B, the only difference being that a calling device CD¹ is associated with it. The substation H terminates in a line switch E¹ similar to E.

Having described in general the apparatus associated with my invention, the operation will now be described.

Assuming now that two local substations such as A and B are to be connected, the subscriber at substation A removes his receiver energizing the relay LR by battery through the line relay LR, normal contact of the jack J, through the substation A to ground at the jack J. The operation of the line relay LR lights the signal S and the operator noting the signal inserts plug P into jack J and throws her listening key LK to ascertain the wants of the calling subscriber. The insertion of the plug P into jack J opens the circuit of the line relay LR which deenergizes and effaces the line signal S. The supervisory relay AS is energized from battery through its lower winding, conductor S, sleeve contacts of the plug P and jack J through the substation, tip contacts of the jack J and plug P, upper winding of relay AS to ground energizing the relay AS which prevents the signal SS from lighting.

Assuming that it is the substation B which is wanted, the operator inserts the plug P¹ into jack J¹ thus lighting supervisory signal SS¹ from ground at the third contact of the jack J¹. The operator then throws her ringing key RK to connect generator M to ring the called-for substation and when the subscriber thereat answers the calling supervisory relay CS is energized effacing supervisory signal SS¹. The subscribers at substations A and B upon finishing conversation replace their receivers upon their respective switch-hooks, the circuit for the relays AS and CS thus being opened effecting the lighting of the supervisory signals SS and SS¹. The operator noting the disconnect signals takes down the connection.

Assuming now that a subscriber at the local substation A at the branch exchange wishes to converse with a subscriber at an automatic substation as H, whose line terminates in an automatic exchange, the subscriber at substation A removes his receiver from its switch-hook, and the operation of the circuit C in Fig. 1 part 1 is the same as before described up to the time the operator plugged into the jack J¹. The operator having thrown her listening key LK to ascertain the wants of the calling subscriber and noting that it is the automatic substation H which is wanted, she inserts the plug P¹ into the trunk jack TJ with her listening key thrown into its alternate position so as to place the calling device CD in operative relation with the trunk circuit D. The listening key LK being thrown, the ground at its alternate contact 24 closes a circuit for the relay DS traced from ground at the alternate contact 24 of LK, the third contacts of the plug P¹ and jack TJ, normal contact

25, through the winding of relay DS to battery energizing relay DS.

The closing of alternate contact 50 of relay DS establishes an energizing circuit for relay SW traced from battery through its winding, closed contacts 29, 30, of the trunk jack TJ, conductor 31, alternate contact 50, normal contact 79, to ground at contact 34, energizing switching relay SW which closes 10 a locking circuit for itself from battery through its winding, closed contacts 29, 30, of jack TJ, alternate contact 34 to ground, this relay remaining energized as long as the plug P¹ is in the jack TJ. The switching 15 relay SW upon energization also switches the control of the supervisory apparatus of the trunk circuit D from the incoming call relay IC to the polarized supervisory relay PSR.

20 As soon as the switching relay SW is energized, the line switch E is automatically operated to step the wipers 3, 4 and 5 to select an idle connector as F, this operation being brought about as follows: Upon the 25 said energization of relay SW its alternate contact 37 is closed establishing an energizing circuit for line relay LR² of the line switch E, traced from battery through the winding of relay LR², the wiper 4, conductor 30 T²; normal contact 13, the normal contact 14, tip conductor T¹ of the trunk D, conductor 36, alternate contact 37, conductor 38, the winding of relay PSR, conductor S¹, normal 35 contacts 17, 18, conductor S² to ground at wiper 5. The energization of relay LR² closes an energizing circuit for cut-off relay CO from ground at alternate contact 19 of relay LR², normal contact 20 of the off-normal contact ON, through the winding of 40 relay CO to battery. Upon energization of relays CO and LR an energizing circuit for the motor magnet MM is established traced from the ungrounded pole of the generator M¹ through the winding of the motor 45 magnet MM, alternate contact 22 to ground at alternate contact 23 of relay LR². The motor magnet MM is energized and steps the wipers 3, 4, and 5 of the individual switch E to select contacts of an idle connector. Upon the first step of the wipers of 50 the switch E off normal, the off-normal contacts ON assume their alternate position and open the initial energizing circuit of the relay CO, but the relay CO remains energized as long as the wiper 3 encounters 55 grounded contacts 3¹ but as soon as the ungrounded contact is encountered, the relay CO deenergizes and disconnects the motor magnet MM to prevent further stepping of the wipers 3, 4 and 5. Relay LR being slow 60 retains its armature attracted until a holding circuit is provided by the selected connector as will be described.

An idle connector as F having been selected by the switch E, the interrupter relay

IR which is bridged across the line conductors of the connector F operates, its circuit being traced from battery through its upper winding, normal contact 35, conductor T³, contact 4¹, wiper 4, conductor T², normal 70 contact 13, normal contact 14, conductor T¹, conductor 36, alternate contact 37, conductor 38, through windings of the polarized supervisory relay PSR, conductor S¹, normal contact 17, normal contact 18, conductor S², 75 wiper 5, contact 5¹, conductor S³, normal contact 39 and through lower winding of relay IR to ground. The battery flow for the polarized relay PSR is in such direction that said relay PSR does not operate but 80 relay SCR being back because key LK and relay DS are still operated ground at normal contact 40 does not affect the cord circuit. The operation of relay IR closes an energizing circuit of release relay RR traced from 85 ground at alternate contact 41 of relay IR, through winding of relay RR to battery. The energization of relay RR closes alternate contact 69 placing a ground upon the private conductor 102 to hold the relay LR² 90 of the switch E energized, the relay LR² remaining energized during conversation.

Trunk D now has its relays DS and SW operated and key LK is in its operated position. At circuit F, relays IR and RR are 95 up.

Assuming that the number of the called automatic substation is 45, the operator actuates the calling device CD to send four impulses over the line to operate the selected 100 connector F. As the calling device leaves its normal position, contact 26 associated therewith assumes its alternate position energizing the dial connecting relay DR by current from battery through the winding 105 of relay DR, alternate contact 27 of relay DS (which was energized when plug P¹ was inserted into trunk jack TJ and the listening key thrown) conductor 28, alternate contact 26 to ground. Relay DR re- 110 mains energized during each operation of the calling device closing its alternate contacts 83 and 84 to connect the calling device to the conductors T² and S² of the line switch. Responsive to the four interrup- 115 tions of the calling device contacts, relay IR deenergizes four times. Upon the first deenergization of relay IR, an energizing circuit for the secondary relay SR and the vertical magnet VM is closed traced from 120 ground through the normal contact 41 of relay IR, alternate contact 42, winding of relay SR, conductor 43, winding of vertical magnet VM through the side switch arm 10 to battery. The relay SR being a slow act- 125 ing relay maintains its armature attracted during the rapid interruptions of its circuit by the relay IR but the vertical magnet VM being quick-acting is responsive to said impulses and steps the wipers 6, 7, and 8 of the 130

connector to the fourth level of switch contacts. The closure of alternate contact 100 of SR establishes an energizing circuit for the private relay PV traced from battery, the winding of relay PV, alternate contact 100 of relay SR to ground, maintaining the armature of PV attracted.

After the first set of impulses relay PV deenergizes having its circuit opened at alternate contact 100 upon the deenergization of relay SR, and mechanically steps the side switch arms 9, 10, 11 and 12 to their second position to engage contacts 44, 45, 46 and 47. The side switch arm engaging the contact 45 places the rotary magnet RM in series circuit with the relay SR to receive the next set of impulses. The operator now actuates the calling device CD to send five impulses to cause five operations of the interrupter relay IR. Upon the first deenergization of relay IR, the relay SR and the rotary magnet RM which are connected in series, are energized from ground at normal contact 41, alternate contact 42, winding of SR, alternate contact 101, the winding of relay RM, side switch contact 45, wiper 10 to battery. The rotary magnet also being quick acting is responsive to the quick interruptions and steps the wipers 6, 7, and 8 to the fifth contacts of the fourth level which are the contacts of the wanted line. The off-normal contacts ON¹ assume their alternate position upon the first step of the switch movement.

After the last set of impulses the operator restores the listening key LK of the cord circuit C removing the ground from the energizing circuit of the relay DS of trunk circuit D. Upon the deenergization of the relay DS a circuit is closed for the signal control relay SCR traced from battery through the winding of the relay SCR, conductor 48, alternate contact 49, normal contact 50, conductor 31, alternate contact 34 to ground. The relay SCR upon energization, closes a locking circuit for itself traced from battery through its winding, alternate contact 51, conductor 31, alternate contact 34 of relay SW to ground. The closing of the alternate contact 25 of relay SCR places a ground upon the third contact of the jack TJ, this ground closing an energizing circuit for the supervisory signal SS¹ traced from battery, lamp SS¹, normal contact 52, normal contact 24, third contacts of the plug P¹ and jack TJ, alternate contact 25, normal contact 40 to ground, lighting the supervisory signal SS¹ which remains lighted until the subscriber at the called-for substation answers.

It will be noted that after the operator has once restored her key LK after the transmission of the impulses, due to locking up of SCR any subsequent manipulation of the listening key does not operate relay

DS and therefore it is impossible to operatively connect the calling device again. This prevents intentional or accidental interference with established connections.

Called line idle.

After the last set of impulses the private relay PV deenergizes having had its circuit opened by the deenergization of SR, to step the side switch arms 9, 10, 11 and 12 to their third position to engage contacts 53, 54, 55 and 56. The arm 10 engaging the contact 54 closes an energizing circuit for the ringing relay RI traced from battery through the side switch arm 10, conductor 57, normal contact 58 of relay RCR, conductor 59 through winding of relay RI, through interrupter I to ground. The relay RI is energized and deenergized to connect the ringing generator M² to the alternate contacts 60 and 61 of relay RI to intermittently ring the call bell at the called-for substation H. When the subscriber at substation H removes his receiver from the switch-hook in response to his call bell, the reversing relay RV operates by current over the called line, circuit being traced from battery through lower winding of reversing relay RV, normal contact 62, conductor S², normal contact 61, wiper 8, contact 8¹, line limb 1² through the substation, line limb 2², contact 7¹, wiper 7, normal contact 60, conductor T², normal contact 63, the upper winding of relay RV to ground. The operation of the relay RV reverses the original flow of battery through the relay PSR of trunk circuit D causing its operation, this energizing circuit of the relay PSR being traced from battery through the upper winding of the relay IR, alternate contact 39, conductor S², contact 5¹, wiper 5, conductor S², normal contact 18, normal contact 17, conductor S¹, windings of relay PSR, conductor 38, alternate contact 37, conductor 36, conductor T¹, normal contact 14, normal contact 13, conductor T², wiper 4, contact 4¹, conductor T³, alternate contact 35, lower winding of relay IR to ground. The contact 40 of relay PSR thus assumes its alternate position opening the circuit of the supervisory lamp SS¹ of the cord circuit C notifying the operator at the branch exchange that the called automatic substation has answered.

The operation of the reversing relay RV also closes an energizing circuit for the ringing control relay RCR traced from battery through the winding of the relay RCR, alternate contact 64, conductor 65, the side switch arm 9 to ground at the contact 53 of the side switch. This energization of the relay RCR opens the circuit for the ringing relay RI at contact 58, the ringing relay RI deenergizing and thus cutting off the ringing current. The relay RCR closes a locking circuit for itself traced from bat-

tery through winding of relay RCR, its alternate contact 66, conductor 65, to ground at contact 53, the relay remaining locked up.

Release.

After conversation has been completed the subscriber at called substation H replaces his receiver upon its switch-hook opening the energizing circuit of the relay RV, the relay RV deenergizing and again causing the reversal of battery through the windings of relay PSR placing the ground upon the third contact of the jack TJ again lighting the supervisory lamp SS¹ of the cord circuit C and thus notifying the operator that the called subscriber has hung up.

The subscriber at the calling substation having replaced his receiver opens the circuit of the relay AS of the cord circuit C lighting lamp SS and the operator noting the two lighted lamps withdraws the plugs P and P¹ from the jacks J and J¹ effacing the lamps. The removal of plug P¹ also opens the circuit for the switching relay SW through contacts 29 and 30 of the jack TJ and the deenergization of relay SW causes deenergization of relay SCR. The deenergization of relay SW also opens the energizing circuit of relay IR of the connector F at alternate contact 37, the said relay IR deenergizing and opening the circuit for release relay RR which operates release magnet REM restoring the connector F. The removal of ground at alternate contact 69 of RR permits the restoration of LR² of switch E whereupon its normal contact 19 is closed energizing relay CO. Relay CO energizing and relay LR² restoring, both retaining pawls are withdrawn allowing the wipers to restore to normal as will be clear from an inspection of Fig. 2.

From the above description it may be seen that the release of the automatic apparatus is under the control of the operator at the local exchange and by the removal of the plug from the trunk jack the automatic apparatus is restored to normal.

Called line busy.

Assuming that the operator has operated the calling device to send the last set of impulses, which are five in number, to select the wanted line of the called substation. Now if the called substation is busy a ground appears at its private contact 6¹ from the alternate contact 19¹ of the individual switch E¹. This ground will establish an energizing circuit for the busy relay BR traced from battery through the upper winding of relay BR, the side switch contact 44, side switch arm 9 which is now in its second position, the conductor 68, private wiper 6, contact 6¹ to ground at alternate contact 19¹ of the line relay LR³ of the

individual switch E¹. The busy relay BR locks up from ground at alternate contact 69 of relay RR, conductor 70, alternate contact 71, lower winding of relay BR through the relay PV to battery. Due to the relay SR being a slow acting relay, it remains energized momentarily preventing the private relay PV from releasing until another circuit is established for it in series with the lower winding of the relay BR. The relay PV remaining energized does not step the side switch wipers, they remaining in their second position. This connects the busy back BB¹ through the alternate contact 72 of relay BR, side switch contact 47, the side switch arm 12, conductor S³, and upon restoration of key LK said signal continues back to the calling substation notifying the calling subscriber that the called line is busy.

The restoration of the operator's listening key causes the operation of relays DS, SW and SCR and lighting of SS¹ as before. The replacing of the calling receiver lights SS. Therefore the operator withdraws the plugs deenergizing SW and SCR as before followed by the deenergization of IR effecting the restoration of the connector and line switch E as will be clear from the foregoing description.

Automatic to branch exchange.

Now assuming that the automatic subscriber at H wishes to call a local substation terminating at the private branch exchange, he removes his receiver which act energizes line relay LR³ of the individual switch E¹. The line relay LR³ operating closes an energizing circuit for cut-off relay CO¹ which in turn closes an energizing circuit for motor magnet MM¹ which steps the wipers 3², 4², 5² to select an idle connector as F in a manner which will be apparent from the previous description.

Assuming now that the automatic substation is calling the number 43 which is the number of one of the trunk lines terminating at the branch exchange, the calling device is operated to send four impulses to step the wipers of the selected connector vertically to the fourth row of contacts. He then operates the dial to send three impulses of current to step the wipers to the third contact in the fourth row which are the contacts 73, 74, 75 associated with a trunk circuit such as D. When the connector wipers stop on the contacts associated with the idle trunk, a ground is placed upon the private contacts 73 to operate the cut-off relay CO of the line switch E to remove the trunk control thereof.

Assuming that the trunk circuit D is in an idle condition, ringing current is applied from the ringing generator, and operates relay IC of the trunk circuit D over a cir-

circuit traced from ringing generator of the connector, the connector, normal contact 60, wiper 7, contact 74, conductor 76, normal contact 14, conductor T¹, conductor 36, normal contact 37, the upper winding of incoming call relay IC, conductor 77, conductor S¹ normal contact 17, conductor 78, contact 75, wiper 8, alternate contact 61, back to the ringing generator. The relay IC is energized and locks up over a circuit traced from battery through the lower winding of the relay IC, alternate contact 79 normal contact 34, to ground. This closes a circuit for the trunk call signal TS traced from battery through the lamp TS, alternate contact 79, normal contact 34 to ground.

The operator at the branch exchange observing the signal TS inserts an answering plug P into the trunk jack TJ operating the switching relay SW, the circuit being traced from battery through the winding of relay SW, closed contacts 29, 30, conductor 31, normal contacts 50, 49, 80, alternate contact 79, normal contact 34 to ground. The switching relay SW upon energization closes a locking circuit for itself traced from battery through the winding of relay SW, contacts 29 and 30 and alternate contact 34 to ground. The contact 34 of relay SW being a make before break contact gives the switching relay SW a chance to lock up through its own contact 34 to ground before the initial energizing circuit is broken. The relay SCR is energized upon energization of the relay SW, the circuit being traced from battery through the winding of relay SCR, alternate contact 49, normal contact 50, conductor 31, alternate contact 34 to ground. The relay SCR closes a locking circuit for itself traced from battery through its winding, alternate contact 51, alternate contact 34 to ground.

Upon energization of relay SW the circuit of relay IC is interrupted to efface signal TS and the closing of alternate contact 37 of SW bridges the polarized supervisory relay PSR across the trunk. Current through relay RV now flows through relay PSR in such direction as to attract the armature of PSR and interrupt normal contact 40 to prevent lighting supervisory lamp SS. Relay RV also energizes and operates relay RCR to prevent further application of ringing current in a manner as before described.

The operator now throws the listening key LK of the cord circuit C and assuming that it is the local telephone A that is wanted, she inserts plug P¹ into the jack J lighting the supervisory signal SS¹. She then throws the ringing key RK to connect ringing generator M to ring the called-for substation A.

The subscriber at A in answering, energizes the calling supervisory relay CS open-

ing the circuit for lamp SS¹. The two substations are now connected in a conversational circuit.

Upon completing conversation the subscribers restore their receivers upon their respective switch-hooks, the restoration at the called substation A effecting the de-energization of relay CS and lighting the signal SS¹. The replacing of the receiver at the calling substation H interrupts the circuit for the associated impulse relay IR which restores closing a circuit for the release magnet REM followed by the restoration of the connector F. Upon the release of the connector, ground is removed from its test conductor 102 by the restoration of release relay RR so that the line switch E¹ restores to normal in a manner which will be clear from the foregoing description.

The said restoration of the connector also removes ground from the private or test contact 73 of the trunk individual switch E whereby its cut-off relay CO restores. This establishes an energizing circuit for the line relay LR² which brings about the operation of the trunk switch D to select an idle connector F whereupon the polarized relay PSR is rendered inert and establishes a circuit for the supervisory signal SS. The foregoing operation is brought about as follows:

Upon said restoration of relay CO a circuit is established traced from battery through the winding of LR², wiper 4 and its normal contact, conductor T², normal contact 13, conductors T¹, 36, alternate contact 37, the winding of PSR, normal contact 17, normal contact 18, conductor S² and wiper 5 to ground. The direction of current flow through relays LR² and PSR is such as to restore relay PSR and the energization of LR² is followed by the energization of CO as before described. Therefore normal contacts 13, 18 of CO are interrupted opening the circuit for PSR and relays CO and LR² being energized switch E advances its wipers until an idle connector is reached. Thereupon relay CO immediately restores connecting the impulse relay IR of the selected connector in circuit with the polarized relay PSR, the current flow being in such direction as to maintain relay PSR inert. Normal contact 40 of the polarized relay is thus maintained closed establishing a circuit for supervisory signal SS¹ and therefore the operator withdraws plugs P and P¹ from the jacks. The withdrawal of the plug from the trunk jack TJ effects the restoration of relays SW and SCR in a manner as already described whereupon the conductive circuit for the impulse relay IR is interrupted at alternate contact 37 of relay SW. Therefore relay IR restores causing an incidental primary step of switch F followed by the release of this switch and

the release of the associated switch E so that all of the apparatus is at normal.

I have also provided means whereby the calling device is operatively disassociated from the trunk should the called subscriber respond prior to the restoration of the listening key. It will be remembered that after a call has been extended by the use of the calling device, the operator restores her listening key which restores the dial switching relay DS and causes the energization of relay SCR so that any further manipulation of the calling device during an established connection is without effect. It may sometimes happen that a called subscriber will respond before the operator has restored her listening key. Therefore the energization of the polarized relay which occurs when the subscriber answers effects the closure of its alternate contact 40 causing the energization of relay SCR so that the interruption of its normal contact 25 restores relay DS. Relay SCR also locks up through its alternate contact 51 in a manner as already set forth. A subsequent restoration of the operator's listening key will therefore have no effect upon the trunk circuit relays. The circuit of relay DS having been interrupted at normal contact 25, it will be apparent that it is impossible to again associate the calling device with the cord circuit by the manipulation of the listening key until the connection has been taken down.

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

1. A telephone system comprising a main automatic exchange, a branch operator controlled exchange, an operator's cord circuit for interconnecting the branch substations, a trunk circuit extending from the branch to the main exchange, a calling device incapable of normal operative association with the trunk circuit, a relay for operatively associating said calling device with said trunk circuit, a listening key for the cord circuit, and means responsive to the connection of the calling plug of the cord with the trunk circuit and the operation of the listening key for rendering said relay capable of being operated to operatively associate said calling device with the trunk circuit.

2. A telephone system comprising an operator's position having a cord circuit for interconnecting telephone lines, a trunk circuit extending from the operator's position to an automatic exchange, a calling device for the trunk circuit incapable of normal operative association therewith, a relay for associating said calling device with said trunk circuit, an operator's key for the cord circuit, and means responsive to the connection of a terminal of the cord with the trunk circuit

and the operation of said key for rendering said relay capable of being operated to operatively associate said calling device with the trunk circuit.

3. A telephone system comprising an operator's position having a cord circuit for interconnecting telephone lines, a trunk circuit extending from the operator's position to an automatic exchange, a calling device for the trunk circuit incapable of normal operative association therewith, an operator's key for the cord circuit, means responsive to the connection of a terminal of the cord with the trunk circuit and the operation of said key for rendering said calling device capable of operative association with the trunk circuit, and means responsive to each operation of the calling device for operatively connecting it with the trunk circuit.

4. A telephone system comprising a cord circuit, a trunk circuit for connecting said cord circuit to an automatic exchange, a calling device for the trunk circuit, two relays adapted to be operated for operatively connecting the calling device with the trunk circuit, an operator's key for the cord circuit, means for operating one of said relays when a terminal of the cord is connected with the trunk circuit and said key is operated for effecting one step in operatively connecting said calling device with the trunk, and means responsive to the operation of the calling device for operating the other one of said relays for operatively connecting the calling device with the trunk.

5. A telephone system comprising a cord circuit, a trunk circuit for connecting said cord with an automatic exchange, a calling device for the trunk circuit, means controlled by the operator for operatively associating said calling device with the trunk circuit, automatic switches responsive to said calling device for extending the trunk circuit to a called line, and means operated upon response from the called substation for operatively disassociating said calling device and trunk circuit.

6. A telephone system comprising a cord circuit, a trunk circuit for connecting said cord with an automatic exchange, a calling device, an operator's key for the cord circuit, means responsive to the actuation of said key and the connection of said cord with the trunk for operatively associating said calling device with the trunk circuit, and means responsive to subsequent restoration of the key to operatively disassociate said calling device and the trunk circuit and prevent their operative association while said cord and trunk remain connected.

7. A telephone system comprising an operator's cord circuit provided with an operator's key, a plurality of trunk circuits

accessible to said cord circuit and extending to automatic switches in an automatic exchange, a calling device common to said trunk circuits, a relay for each of said trunk circuits for operatively associating said calling device with its respective trunk circuit, means for connecting said cord circuit with one of said trunk circuits, a circuit for the relay of the connected trunk circuit including contacts of said operator's key, and means for operating said relay to operatively associate the calling device with said trunk circuit.

8. A telephone system comprising an operator's cord circuit provided with an operator's key, a plurality of trunk circuits accessible to said cord circuit and extending to automatic switches in an automatic exchange, a calling device common to said trunk circuits, a relay for each of said trunk circuits for operatively associating said calling device with its respective trunk circuit, means for connecting said cord circuit with one of said trunk circuits, a circuit for the relay of the connected trunk circuit including contacts of said operator's key, and means for operating said relay to operatively associate the calling device with said trunk circuit, and a subscriber controlled relay for said trunk circuit for operatively disassociating said calling device and said trunk circuit.

9. A telephone system comprising an operator's cord circuit provided with an operator's key, a plurality of trunk circuits accessible to said cord circuit and extending to equipment in an automatic exchange, a calling device common to said trunk circuits, electromagnetic means for each of said trunk circuits for operatively associating said calling device with said trunk circuits, means for operatively disassociating said calling device from a connected trunk circuit, and electromagnetic means for preventing a reassociation of said calling device with a trunk circuit while said cord circuit is operatively connected to said trunk circuit.

10. A telephone system including a trunk circuit extending from a manual exchange to an automatic exchange, a calling device, electromagnetic means for operatively associating said calling device and said trunk circuit, subscriber controlled means for operatively disassociating said calling device and said trunk circuit and for preventing a reassociating thereof prior to the disconnection of the subscriber from the trunk circuit.

11. A telephone system including a two way trunk circuit extending from a manual exchange to an automatic exchange, a calling device, means for operatively associating said calling device with said trunk circuit when said circuit is used to extend a

call in one direction, and means for preventing an operative association of said calling device and said trunk circuit when said trunk circuit is used to extend a call in the opposite direction.

12. A telephone system comprising an operator's cord circuit provided with an operator's listening key, a trunk circuit, a calling device associated with said trunk circuit but normally disconnected therefrom, means for connecting said cord circuit with said trunk circuit, electromagnetic means for operatively associating said calling device with said trunk circuit, a circuit for said electromagnetic means including contacts of said operator's listening key, and means for operating said electromagnetic means to operatively associate said calling device and said trunk circuit.

13. A telephone system comprising an operator's cord circuit provided with an operator's listening key, a trunk circuit, a calling device associated with said trunk circuit but normally disconnected therefrom, means for connecting said cord circuit with said trunk circuit, electromagnetic means for operatively associating said calling device with said trunk circuit, a circuit for said electromagnetic means including contacts of said operator's listening key, and means for operating said electromagnetic means to operatively associate said calling device and said trunk circuit, and means responsive to an operation of said operator's key to disassociate said calling device and said trunk circuit and prevent a reassociation of said calling device and said trunk circuit while said cord circuit is operatively connected to said trunk circuit.

14. A telephone system comprising a trunk circuit extending to an automatic exchange, a rotary manually operable calling device for said trunk circuit, and a relay individual to the said trunk circuit energized responsive to each operation of said calling device when dialing a number for directly connecting said calling device to said trunk circuit.

15. A telephone system including an operator's position, a plurality of trunk circuits extending from said operator's position to automatic equipment in an automatic exchange, a calling device common to said trunk circuits, electromagnetic means individual to each of said trunk circuits for operatively associating said calling device with said trunk circuits, and means responsive to an operation of said calling device for operating the electromagnetic means of a trunk circuit to operatively associate said calling device with said trunk circuit prior to an operation of said automatic equipment.

16. A telephone system including an operator's cord circuit, a plurality of trunk

circuits accessible to said cord circuit and extending to equipment in an automatic exchange, a calling device common to said trunk circuits, and means responsive to the
 5 connecting of said cord circuit with one of said trunk circuits and an operation of said calling device for operatively associating the calling device with the connected trunk circuit.

10 17. A telephone system comprising a link circuit, a trunk circuit for connecting said link circuit with automatic equipment, a calling device for said trunk circuit, means controlled by an operator for operatively associating said calling device with the trunk
 15 circuit, automatic equipment responsive to said calling device for extending a call to a called line, and means operated upon response from the called substation to operatively disassociate said calling device and
 20 said trunk circuit and for preventing a re-association of said calling device and said calling circuit while said link circuit is connected to said trunk circuit.

25 18. A telephone system including a trunk circuit extending from a manual exchange to an automatic exchange, a calling device, electromagnetic means individual to said trunk circuit for operatively associating
 30 said calling device with said trunk circuit, and subscriber-controlled means for operatively disassociating said calling device from said trunk circuit.

35 19. A telephone system including a trunk circuit extending to an automatic exchange, a calling device, an operator's cord circuit provided with a listening key, and electromagnetic means responsive to an actuation
 40 of said listening key and an operation of said calling device for operatively associating said calling device and said trunk circuit.

45 20. A telephone system including an operator's link circuit, a trunk circuit, a calling device, manual means for connecting said trunk circuit directly to said link circuit, and means responsive to a control exerted at said link circuit and an operation
 50 of said calling device for operatively connecting said calling device with said trunk circuit.

55 21. A telephone system including an operator's link circuit provided with a key, a trunk circuit, a calling device, a simple relay adapted upon energization to operatively associate said calling device with said trunk
 60 circuit, and means dependent upon an actuation of said key and an operation of said calling device for actuating said relay to operatively associate said calling device with said trunk circuit.

65 22. A telephone system including a trunk circuit, a calling device, a rotary manually operable setting member for said calling device, a pair of contacts adapted to be actu-

ated each time said setting member is operated, a key, a relay individual to said trunk circuit for connecting said calling device with said trunk circuit, and a circuit for said relay controllable by said key and
 70 said contacts.

23. A telephone system including a trunk circuit, an operator's rotary impulse-sending device, off-normal springs adapted to be closed upon each actuation of said impulse-sending device, and a relay individual to
 75 said trunk circuit provided with a circuit including said contacts adapted to be energized upon each operation of said device for associating said device with said trunk circuit.

24. A telephone system including a trunk circuit, an operator's impulse-sending device, a relay responsive to an operation of said device for associating said device with
 85 said trunk circuit, and subscriber-controlled means for disassociating said sending device and said trunk circuit.

25. A telephone system including an operator's link circuit provided with a key, a
 90 calling device, a rotary manually operable setting member for said calling device, off-normal springs adapted to be actuated upon each operation of said setting member, and a relay individual to said trunk circuit controllable by said key and the off-normal
 95 contacts of said calling device for operatively associating said calling device with said link circuit.

26. A telephone system including an operator's link circuit provided with a key, a
 100 trunk circuit connected to said link circuit, a calling device, means controlled by said key and said calling device for connecting said calling device with said trunk circuit, a numerical switch, and a non-numerical switch for connecting said trunk circuit to
 105 said numerical switch.

27. A telephone system including operators' cord circuits provided with listening
 110 keys, trunk circuits, a calling device common to said trunk circuits, manual means for connecting one of said cord circuits to said trunk circuit, and electromagnetic means for said trunk circuit operable in response to an operation of the listening key
 115 of said cord circuit for associating said calling device with said trunk circuit.

28. A telephone system including a trunk circuit terminating in a manual connection
 120 terminal and in an automatic switch, a calling device, and means individual to said trunk circuit and controlled by the calling device for connecting said device to said trunk circuit.

29. A telephone system including an operator's link circuit, a trunk circuit extending from a manual exchange to an automatic exchange, a calling device, means responsive to an operation of said calling device
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to connect said calling device with said trunk circuit, said means including a relay provided with a circuit the closure of which is contingent upon an operation of said calling device and the connection of said link circuit to said trunk circuit.

30. A telephone system including a trunk circuit terminating in a manual connection terminal and in an automatic switch, an operator's calling device, and a relay adapted when operated to connect the said calling device with said trunk circuit and to operate said automatic switch.

31. A telephone system including a trunk circuit terminating in a manual connection terminal and in an automatic switch, a calling device, a relay individual to said trunk circuit for connecting said calling device to said trunk circuit, and means responsive to the connection of said calling device to said trunk circuit for operating said automatic switch.

32. A telephone exchange system including a trunk circuit terminating in a manual connection terminal and in an automatic switch, a key, a calling device, a relay, means for operating said relay to connect said calling device to said trunk circuit responsive to an operation of said calling device and said key, said automatic switch being operable responsive to the connection of said calling device with said trunk circuit.

33. A telephone system including an operator's cord circuit provided with a key, a trunk circuit, a calling device, a pair of relays for said trunk circuit, means for operating one of said relays responsive to an actuation of said key, thereby preparing a circuit for the other of said relays, and means responsive to an actuation of said calling device to operate said other relay to opera-

tively associate said calling device with said trunk circuit.

34. A telephone system including an operator's cord circuit provided with a key, trunk circuits, a calling device common to said trunk circuits, and electromagnetic means individual to each of said trunk circuits and responsive to an actuation of said calling device to connect said calling device with a trunk circuit.

35. A telephone system including an operator's cord circuit, trunk circuits, a calling device common to said trunk circuits, means for connecting said operator's cord circuit to any of said trunk circuits, and means individual to a trunk circuit operated responsive to an actuation of said calling device for connecting said calling device to the trunk circuit to which said cord circuit has been connected.

36. A telephone system including an operator's cord circuit, trunk circuits, a calling device common to said trunk circuits, means for connecting said operator's cord circuit to any of said trunk circuits, means individual to a trunk circuit operated responsive to an actuation of said calling device for connecting said calling device to the trunk circuit to which said cord circuit has been connected, and means for preventing a subsequent actuation of said calling device from again connecting said calling device to said trunk circuit.

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

GEORGE D. WOLF.

Witnesses:

GEORGE E. MUELLER,
B. O'BRIEN.