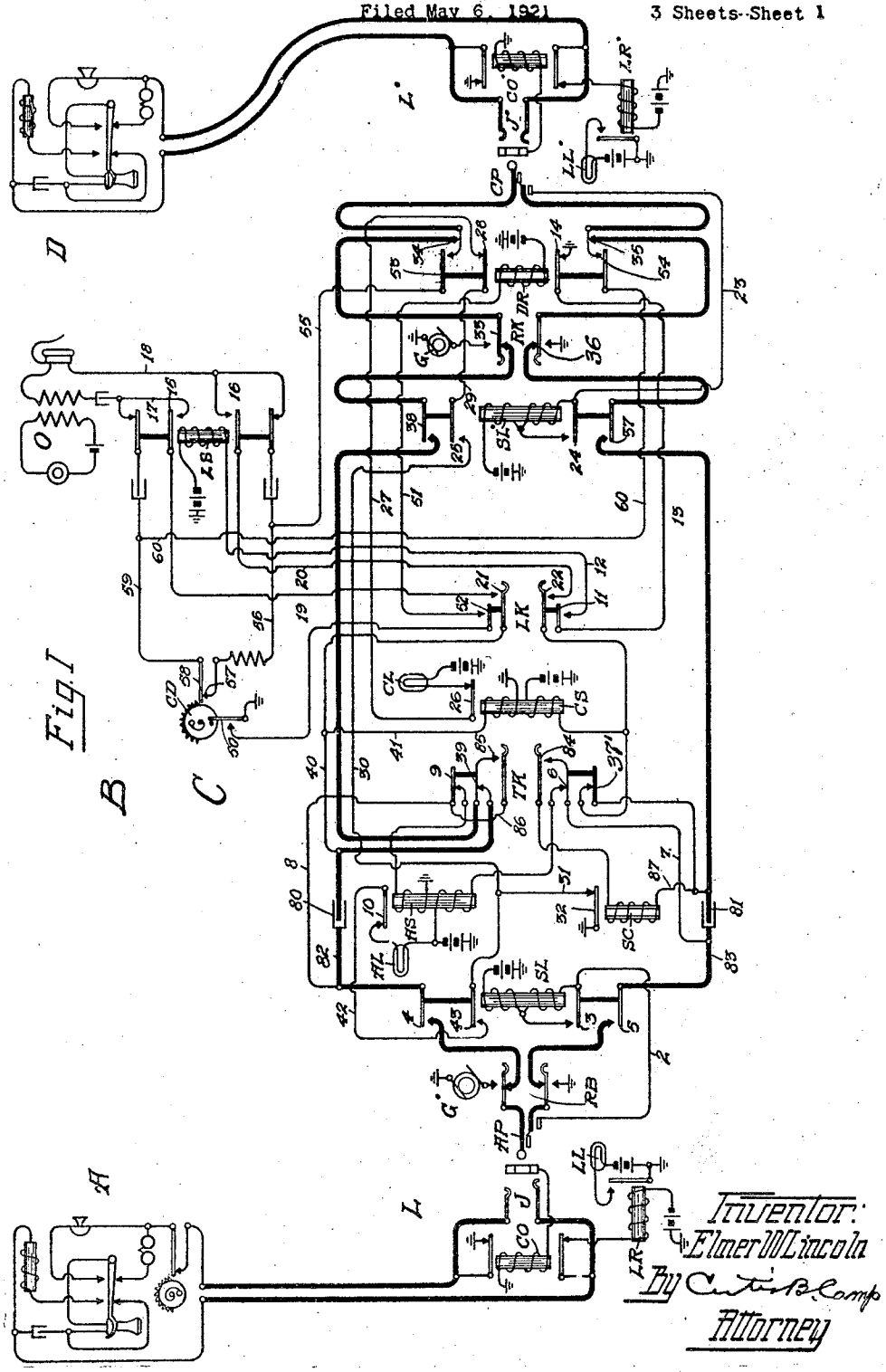
May 20, 1924. 1,494,555

E. W. LINCOLN

TELEPHONE SYSTEM

Filed May 6, 1921 3 Sheets-Sheet 1



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Filed May 6, 1921 3 Sheets-Sheet 2

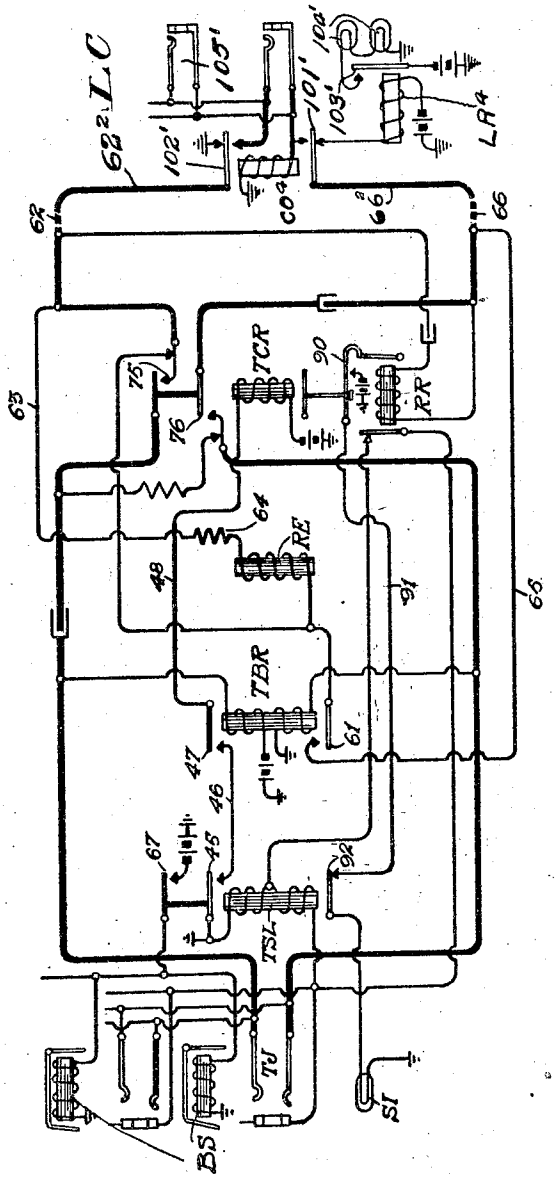

Fig. 2.

TC

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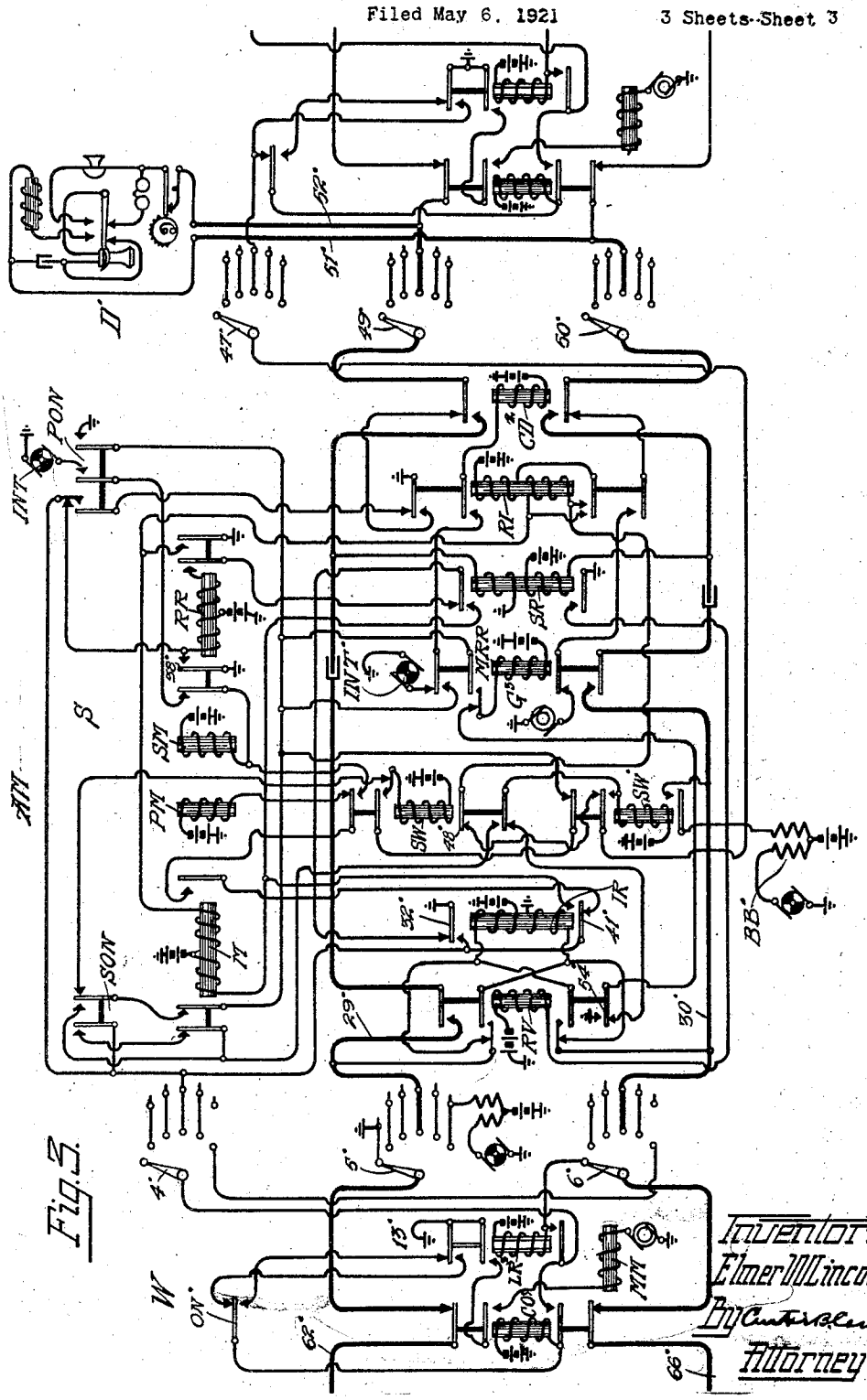

Fig. 5.

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Patented May 20, 1924. 1,494,555

UNITED STATES PATENT OFFICE.

ELMER W. LINCOLN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed May 6, 1921. Serial No. 467,257.

To all whom it may concern:

Be it known that I, ELMER W. LINCOLN, a citizen of the United States of America, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with private branch exchange systems such as are used for interconnecting local subscribers terminating at a branch exchange switchboard, and for also connecting local subscribers and main exchange subscribers; and an object of my invention is the provision of an improved circuit arrangement which has desirable features of operation, all in a simple, efficient and economical manner.

In private branch exchange systems of the above type, it is desirable to connect the branch exchange subscribers with main exchange subscribers in both manual and automatic telephone exchanges, and a feature of my invention is the provision of means under the control of the operator which may be used for extending the connection to a main exchange of the manual or automatic type. In case the called main exchange subscriber's line terminates at an automatic exchange, a calling device in the branch exchange transmits impulses to actuate the apparatus at the automatic exchange to extend the call from the branch exchange substation to that of the called subscriber in the main exchange.

Another feature of my invention is the provision of means whereby, should the branch exchange subscriber be equipped with a calling device, the operator at the branch exchange may actuate a key switching means for enabling the subscriber at the branch exchange to extend the call to the main exchange called subscriber at the automatic exchange.

Still another feature of my invention is the provision of a trunk circuit for connecting a private branch exchange subscriber to a main exchange subscriber at an automatic exchange or to one at a manual exchange. It is of the two-way type, so it can be used for extending connection to a branch exchange subscriber from a main exchange subscriber, or for extending a connection to a main exchange subscriber from a branch exchange subscriber.

The features above outlined, as well as others, will be more fully hereinafter described in the ensuing specification.

For a better understanding of my invention, reference may be had to the accompanying drawings, in which—

Fig. 1 diagrammatically illustrates the cord circuit of my invention for interconnecting subscribers terminating at the branch exchange; and

Fig. 2 illustrates diagrammatically the two-way trunk circuit of my invention used for extending connections from or to the main exchange, and also shows its line conductors 62 and 66 terminating in a line circuit LC at a main manual exchange.

Fig. 3 illustrates the automatic mechanism of an automatic exchange and when placed to the right of Fig. 2 so that conductors 62′ and 66′ will connect to conductors 62 and 66 respectively, a system will be shown wherein my invention is used for extending a call to a main automatic exchange.

Referring now particularly to Fig. 1, to the left of the drawing I illustrate at A a branch exchange substation connected at the branch exchange switchboard with a line circuit L, comprising a line relay LR, line signal LL, cut-off relay CO and answering jack J. At C I illustrate one of a plurality of branch exchange cord circuits with which the board is equipped for interconnecting the branch exchange subscribers and also for use in extending connections to the main exchange. The cord circuit C is provided with an answering plug AP and a calling plug CP, which are connected by the heavily marked talking conductors. At the answering end of the cord circuit C I provide a sleeve relay SL which, when a plug AP is inserted into the jack J of a calling line, is energized. An answering supervisory relay AS is provided, which relay AS controls the answering supervisory lamp AL. The answering end of the cord circuit C is also provided with a ringback key RB for the usual purposes. A through dialing key TK is provided which is actuated by the operator to permit a calling branch exchange substation that is equipped with a calling device to

actuate apparatus at the main exchange of the automatic type to extend the call to the called main exchange subscriber's line. A combined listening and dialing key LK is also provided which is actuated for the usual listening purposes, which key LK when actuated energizes the listening relay LS to connect the operator's set O to the cord conductors of the cord C. A calling device CD is also provided which is common to an operator's position and is also connected to the cord circuit conductors to transmit impulses to an automatic main exchange to select the called main exchange subscriber, as will be more fully hereinafter described. A supervisory signal control relay SC is also provided which is connected in circuit when the through dialing key is actuated, for purposes as will be more fully hereinafter described. The calling end of the cord circuit C is provided with a sleeve relay SL′ and a calling supervisory relay CS, which relay CS controls the calling supervisory signal CL. A ringing key RK is also provided which, when actuated, connects the ringing generator G to actuate the call signal at the called branch exchange substation. A dial connecting relay DR is provided, which relay is energized during the time the operator is sending impulses to the main automatic exchange so as to connect the calling device CD to the cord conductors.

To the right of the drawing I have shown a called branch exchange substation D similar to substation A and which connects at the branch exchange board with a line circuit L′, comprising the line relay LR′, line signals LL′, cut-off relay CO′ and jack J′.

Two-way trunk circuits as TC are provided in addition to the local cords for connecting the branch exchange substations with either a manual or automatic main exchange. The trunk circuit TC as illustrated in Fig. 2 terminates at the branch exchange in a trunk jack TJ, multipled through the branch exchange board. The conductors 62 and 66 of the trunk circuit TC will terminate at the main exchange in a suitable line circuit, if it is a manual exchange, or in suitable automatic switching mechanism, should the trunk terminate at a main automatic exchange.

In Fig. 2, I show the conductors 62 and 66 of trunk circuit TC extending by the dotted lines to conductors 62^2 and 66^2 respectively of a line circuit LC located at the manual main exchange. The line circuit LC comprises, a relay LR^4, multiple lamps 104′ and multiple jacks 105′ and cut off relay CO^4. The relay LR^4 will operate, when connection is made with the trunk circuit TC at the branch exchange, to cause multiple lamps 104′ to light and when an operator at the manual main exchange inserts the answering plug of one of her cord circuits, cut off relay CO^4 will operate to cause relay LR^4 to restore to efface lamps 104′. The cord circuit at the main exchange may be of any of the well known two conductor type and illustration and description of the same is deemed unnecessary for a clear understanding of my invention.

On the other hand should my trunk circuit TC extend to an automatic exchange, conductors 62 and 66 in this case would not be connected to conductors 62^2 and 66^2 of the main manual exchange but will be connected to conductors 62′ and 66′ of the automatic exchange.

In addition I provide trunk signal SI, which is lighted when a call is extended to the branch exchange switchboard to notify the operator that a call is awaiting her attention. Busy signals BS are also provided and may be of the mechanical target type. They appear before the branch exchange operators to indicate to them that a trunk is in use. The trunk TC is provided with a ringing relay RR, which upon energization mechanically locks its armature in its attracted position, and a trunk cord conductor control relay TCR mechanically associated with the relay RR is also provided, which upon energization extends the trunk cord conductors to the main exchange, and, through the agency of mechanical means, unlocks the armature of relay RR to permit it to restore. A trunk sleeve relay TSL is provided and a trunk bridging relay TBR is also provided which upon energization bridges a retardation coil RE across the trunk cord conductors for purposes as will be more fully hereinafter described.

Having described in general the apparatus embodying my invention, I will now describe in detail its operation.

Assuming now that the branch exchange subscriber at the substation A initiates a call, the removal of the receiver at the substation closes an energizing circuit for the line relay LR of the branch exchange line circuit L, and the line relay LR energizing closes its alternate contact to light the line signal LL. The branch exchange operator observing the lighted line signal LL will insert the answering plug AP of the branch exchange cord circuit C into the jack J of the calling line, thus establishing an energizing circuit which may be traced from battery through the windings of the sleeve relay SL, conductor 2, the sleeve contacts of the connected plug AP and jack J, to ground through the winding of the cut-off relay CO of the line circuit L. The sleeve relay SL and the cut-off relay CO are energized over this circuit, and the relay CO energizing opens the circuit of and allows the line relay LR to restore and efface the line signal LL. The closing of alternate contact 3 of the sleeve relay SL closes a

circuit through the upper winding of the said relay SL from battery through its upper winding, its alternate contact 3, to ground through the winding of the cut-off relay CO, said relays CO and SL remaining energized until the plug AP is withdrawn. The closing of alternate contacts 4 and 5 of the relay SL closes an energizing circuit for the answering supervisory relay AS, traced from battery, through the lower winding of the relay AS, normal contact 6 of the through dialing key TK, conductor 7, alternate contact 5 of sleeve relay SL, through the ring contacts of the connected plug AP and jack J, through the closed contacts at the substation switchhook, back through the tip contacts of the plug AP and jack J, alternate contact 4 of the relay SL, conductor 8, normal contact 9 of the key TK, through the upper winding of the relay AS to ground. Said relay upon energization opens normal contact 10 to prevent the answering supervisory lamp AL from lighting at this time. The operator now actuates her combined listening and dialing key LK, and the closing of alternate contact 11 of the listening key LK closes an energizing circuit for the listening relay LS, traced from battery through the winding of the relay LS, conductor 12, alternate contact 11 of the key LK, conductor 13, to ground at normal contact 14 of the dial connecting relay DR. The relay LS energizing closes its alternate contacts 15 and 16, to connect the operator's set O to the cord conductors, over conductors 17 and 18, through the alternate contacts 15 and 16 of relay LS, conductors 19 and 20, through alternate contacts 21 and 22 of the listening key LK, to the cord conductors.

The operator now inquires the want of the calling subscriber at the branch exchange substation A, and assuming that it is the branch exchange subscriber D that is wanted, she tests the jack J′ in the usual manner, and assuming that it is idle, inserts the calling plug CP into the jack, establishing a series energizing circuit for the sleeve relay SL′ and the cut-off relay CO′ of the line circuit L′. The sleeve relay SL′ energizing closes its alternate contact 24, which closure shunts out its lower winding and establishes a circuit from battery through the upper winding of the sleeve relay SL′, through its alternate contact 24, conductor 23, to ground through the cut-off relay CO′. The closing of alternate contact 25 establishes a circuit for the calling supervisory lamp CL, traced from battery through the lamp CL, normal contact 26 of the calling supervisory relay CS, conductor 27, normal contact 28 of the relay DR, conductor 29, alternate contact 25 of relay SL′, conductors 30 and 31 to ground at normal contact 32 of its supervisory signal control relay SC. The calling supervisory lamp CL is lighted over this circuit and remains in its lighted condition until the called subscriber at the substation D answers. The operator now actuates the ringing key RK, which connects ringing generator G, the ringing current circuit to the called substation being traced from the ungrounded pole of the generator G, alternate contact 33 of the ringing key RK to the normal contact 34 of the relay DR, tip contacts of the connected plug CP and jack J′, through the condenser and call bell at the called substation, back through the ring contacts of the connected jack J′ and plug CP, normal contact 35 of the relay DR to ground at alternate contact 36 of the ringing key RK. The subscriber at the branch exchange substation D, in response to his call signal, removes the receiver from its switchhook, and the closing of the switchhook contacts establishes an energizing circuit for the calling supervisory relay CS, traced from battery through the lower winding of the relay CS, normal contact 37′ of key TK, alternate contact 37 of the sleeve relay SL′, normal contact 36 of the ringing key RK, normal contact 35 of the relay DR, the ring contacts of the connected plug CP and jack J′, through the now closed contacts of the branch exchange substation switchhook, back through the tip contacts of the connected jack J′ and plug CP, normal contact 34 of the relay DR, normal contact 33 of the ringing key RK, alternate contact 38 of the sleeve relay SL′, normal contact 39 of the through dialing key TK, conductors 40 and 41, through the upper winding of the supervisory relay CS to ground. The calling supervisory relay CS is energized over this circuit, and the opening of normal contact 26 of the relay CS opens the circuit of the lamp CL, and the said lamp is thus effaced, indicating to the operator that the called subscriber at D has answered. The restoration of the listening key LK opens alternate contact 11 and interrupts the circuit of the listening relay LS, which relay restores, and the key also upon restoration disconnects the operator's set O from the cord conductors. The subscriber at the substation A and the subscriber at the substation D are now in conversational circuit, the circuit being traced over the heavily marked conductors.

The subscribers having finished conversation replace their receivers upon the respective switchhooks, and the replacing of the receiver at the calling substation A opens the energizing circuit of the answering supervisory relay AS at the switchhook contacts, and the relay AS, therefore, restores, and the closing of its normal contact 10 establishes an energizing circuit for the answering supervisory lamp AL, traced from battery, through the lamp AL, nor-

mal contact 10 of relay AS, conductor 42, alternate contact 43 of the sleeve relay SL, conductor 31 to ground at normal contact 32 of the relay SC. The subscriber at the substation D replacing his receiver opens the energizing circuit of the calling supervisory relay CS at the switchhook contacts and the said relay CS upon de-energization closes its normal contact 26, establishing a circuit for the calling supervisory signal CL, to ground at normal contact 32 of the relay CS, over the circuit as previously described. The operator noting the lighted supervisory signals AL and CL, knows that conversation has been completed and the subscribers have replaced their receivers upon their respective switchhooks, and she, therefore, withdraws the answering plug AP and calling plug CP from their respective jacks J and J′, and the withdrawal of the plug AP from jack J opens the series energizing circuit of the cut-off relay CO and the sleeve relay SL, said relays CO and SL restoring. The opening of alternate contact 43 of the relay SL opens the circuit of the answering supervisory lamp AL, the said lamp AL being thus effaced. The withdrawal of the calling plug CP from the jack J′ opens the series energizing circuit for the cut-off relay CO′ and sleeve relay SL′, and the sleeve relay SL′ upon restoration opens its alternate contact 25, opening the circuit through the calling supervisory lamp CL, and the lamp CL is thus effaced. The apparatus used in establishing connection between the two branch exchange substations A and D is now at normal and available for use in establishing other connections.

Assuming now that the branch exchange subscriber at the substation A calls and wishes to converse with a subscriber at an automatic main exchange, the operation of the branch exchange apparatus is the same as before described, up to and including the time that the operator actuates her combined listening and dialing key LK, to connect her set to the cord conductors, as before described. The operator having inquired the want of the calling substation A of the branch exchange and having received the number of the main exchange automatic subscriber, now permits the combined listening and dialing key LK to remain in its actuated position. The operator now inserts the calling plug CP into an idle trunk jack TJ leading to the automatic main exchange, this idle condition being indicated by the signals BS, as will be more fully hereinafter described. The insertion of the plug establishes an energizing circuit for the sleeve relay SL′ of the cord circuit C of the branch exchange switchboard, and the trunk sleeve relay TSL of the trunk circuit TC, traced from battery, through the windings of the relay SL′, conductor 23, sleeve contacts of the connected plug CP and trunk jack TJ, through the windings of the trunk sleeve relay TSL to ground.

The relay TSL of the trunk circuit TC energizing closes its alternate contact 45, energizing the trunk cord conductor control relay TCR, from ground through alternate contact 45 of relay TSL, conductor 46, through alternate contact 47 of the trunk bridging relay TBR, conductor 48, through the winding of the relay TCR to battery. The trunk bridging relay TBR was also energized when the plug CP was inserted into the jack TJ, its circuit being traced from battery through the upper winding of the relay TBR, the tip contacts of the connected plug CP and jack TJ, normal contact 34 of the relay DR, alternate contact 38 of the sleeve relay SL′, normal contact 39 of the key TK, conductors 40 and 41, through the upper winding of the relay CS of the cord C, to ground. Another circuit also extends from ground through the lower winding of the relay TBR, through the ring contacts of the connected plug CP and jack TJ, the normal contact 35 of the relay DR, alternate contact 37 of the relay SL′, normal contact 37′ of key TK, through the lower winding of the relay CS to battery. The operator at the branch exchange B having operated the listening key LK and received the number of the called subscriber at the automatic exchange, now actuates the calling device CD associated with the operator's cord C of the branch exchange B to send a group of impulses to actuate the automatic switching mechanism at the main automatic exchange. Upon the initial energization of the relay TBR, its alternate contact 61 was closed, bridging the retardation coil RE across the trunk conductors, the circuit being traced from the tip conductor 62, conductor 63, through the winding 64, through the winding of the retardation coil RE, through alternate contact 61 of relay TBR, conductor 65, to the sleeve conductor 66 of the trunk circuit TC. The retardation coil RE being thus bridged across the trunk conductors upon the energization of relay TBR closes a circuit for relay LR^3 of the finder switch W said circuit being traced from battery through the winding of said relay LR^3, wiper 6′, lower normal contact of relay of CO^3, conductors 66′ (which in this case will be connected to conductors 66 of trunk circuit TC) conductor 65 alternate contact 61 of relay TBR, through the winding of retardation coil RE, conductors 63 and 62, conductor 62′ upper normal contact of relay CO^3, contact wiper 5′ to ground. Relay LR^3 will energize over this circuit and will close a circuit from the ground through the closed contact on the off normal switch ON to the cut off relay CO^3. At the same time a

ground from 13′ is placed upon two of the armatures of the cut-off relay CO^3 due to the attraction of the two upper armatures of the relay LR^3. The cut off relay CO^3 operates and thereupon closes a circuit through the magnet MM and the intermittent source of current terminating at the ground 13, whereupon this motor magnet actuates the wipers 4′, 5′ and 6′ to select a non-busy connector switch S. The very first movement of the wipers off normal of course transfers the off normal contacts ON′ to its alternative position. The transference of this off normal contact opens the circuit through the cut-off relay CO^3 but this cut off relay is maintained energized so long as the wiper 4′ finds a grounded contact, thereby keeping the circuit through the motor magnet MM closed. When an idle connector is reached, the cut off relay CO^3 is de-energized and opens the circuit of the motor magnet. The relay LR^3 is slow acting and holds momentarily even though the cut-off relay releases until this relay LR^3 again finds its circuit closed as will now appear. As soon as the wipers 5′ and 6′ reach the terminals of the line conductors 29′ and 30′ of the connector switch S at the automatic exchange AM, impulse relay IR is energized as is readily apparent by being connected to both of these conductors 29′ and 30′ which are now extended through to the conductors 62 and 66 respectively of trunk circuit TC. The foregoing will happen upon the insertion of the plug CP into the trunk jack TJ and before the operator at the branch exchange B has time to operate her calling device CD to send impulses of current to the automatic exchange. The operator at B will now actuate her calling device CD to cause impulses of current to be transmitted to operate the automatic switch S to cause the same to connect to the called for subscriber's line D′. When the calling device CD is actuated and upon the movement of said calling device CD off-normal, contact 50 is closed, to establish a circuit for the dial connecting relay DR, traced from battery through the winding of the said relay DR, conductor 51, alternate contact 52 of the key LK, to ground at the off-normal contact 50 of the calling device CD. The relay DR energizing closes its alternate contacts 53 and 54 and opens its normal contacts 34 and 35, thus opening the initial energizing circuit of the relay TBR of the trunk circuit TC and relay CS of the cord C, but due to the closing of the make before break contacts 53 and 54 of the relay DR, the circuit of the said relay TBR now extends from battery through the upper winding of the relay TBR, tip contacts of the connected plug CP and jack TJ, through alternate contact 53 of the relay DR, conductors 55 and 56, through the impulse spring contacts 57 and 58 of the calling device CD, conductors 59 and 60 through alternate contact 54 of the relay DR, ring contacts of the connected plug CP and jack TJ, to ground through the lower winding of the relay TBR. The relay CS upon de-energization closes its normal contact 26, lighting the lamp CL, but as soon as the operator actuates the calling device CD and the relay DR energizes, the lamp CL is effaced. After the calling device CD has been set in accordance with the first digit, it is released, and upon its return movement a series of impulses of a predetermined number will be sent due to the interruption of the impulse spring contacts 57 and 58 of the calling device CD, and upon each interruption the trunk bridging relay TBR will be de-energized, so the interruptions of the contacts 57 and 58 bring about a predetermined number of de-energizations and energizations of the relay TBR, and the vibrations of contact 61 of the relay TBR repeats the impulses to the impulse relay IR of switch S at the automatic exchange. Upon the first de-energization of the relay TBR, its alternate contact 47 is opened and the relay TCR of the trunk circuit TC de-energizes, and due to the construction and adjustment of its armature, and of the spring tension of its contact springs, it is not re-energized during the rapid vibrations of contact 47 of the relay TBR, but remains in its de-energized condition. The relay TSL having energized upon the insertion of the plug CP into the trunk jack TJ, as before described, closed its alternate contact 67, establishing a circuit through the mechanical type busy signals BS, traced from battery through alternate contact 67, of relay TSL and through the busy signals BS at the branch exchange switchboard B to ground. The busy signals BS are actuated and display a suitable target, which indicates to the operators at the branch exchange that the trunk is being used for extending a connection to a main exchange. After each set of impulses the alternate contact 50 of the off-normal spring of the calling device CD is opened, thus opening the energizing circuit for the relay DR, but the relay DR, due to its slow-to-release construction, is held up momentarily so that upon the calling device CD the contact 50 will again be closed, and during the sending of the impulses by the operator at the branch exchange B the relay DR will be energized. Upon the first energization of relay IR, relay RR energizes and locks up to ground through its alternate contact 38′. Relay M does not operate at this time due to its differential construction. The operator at B, upon sending the first series of impulses will cause the impulse relay IR to de-energize and energize a pre-

determined number of times and upon the first de-energization of said relay IR, primary off-normal contacts PON will move to their alternate position and due to the opening of alternate contact 41′ of relay IR, relay M will energize and will remain energized during the transmission of the first series of impulses. Relay M energizing closes a circuit for the primary magnet PM which magnet PM is caused to energize and de-energize by the operation of impulse relay IR, to bring the contact wipers 47′, 49′ and 50′ opposite the bank of contacts in which the line conductors 51′ and 52′ of the substation D′ terminate. After the last impulse, of this series of impulses, by which the primary magnet PM is operated, relay 1R will remain energized due to the fact that relay TBR in trunk circuit TC is energized which maintains a closed circuit for said relay IR. Relay M will now de-energize whereby a circuit is established for the switching relay SW and relay SW energizing locks itself up, whereby the circuit for primary magnet PM is broken and a circuit is established for secondary magnet SM. The circuit for the private wiper 47′ is opened at armature 48′ of relay SW. A second series of impulses is now transmitted to cause relays IR and M to operate as before described, and relay SM operates to move wipers 47′, 49′ and 50′, to bring the same into engagement with contacts leading to the called subscriber's line wires 51′ and 52′. Upon the first step of the wipers off normal, the secondary off normal switching device SON moves to its alternate position. Furthermore, after the last impulse, relay M, de-energizes whereupon relay SW′ energizes and opens the circuit of relay SW which will cause relay SW to restore whereupon relay SW′ will be connected in multiple circuit with relay MRR through contact 54′ of relay RV.

After the last series of impulses are sent, the off-normal contact 50 of the calling device CD opens and the circuit through the dial connecting relay DR is interrupted, and the relay DR de-energizing opens its alternate contacts 53 and 54 and again closes its normal contacts 34 and 35. The said contacts 53 and 54 upon opening interrupt the circuit of the trunk bridging relay TBR of the trunk circuit TC, which extended through the contacts 57 and 58 of the calling device CD, but due to the closure of normal contacts 34 and 35 the relay TBR will remain energized through the windings of the calling supervisory relay CS of the cord circuit C at the branch exchange B, over a circuit as previously described, and the opening of the normal contact 26 for the relay CS of the cord circuit B effaces the signal CL. The closing of alternate contact 47 of the relay TBR of the trunk circuit TC again closes an energizing circuit for the trunk cord conductor control relay TCR, and the closing of its alternate contacts 75 and 76 completes the continuity of the trunk conductors 62 and 66, which lead to the main exchange AM. If the called subscriber's line is busy there will be a ground on the contact engaged by private wiper 47′, which will prevent relay SW′ from de-energizing whereby the busy buzzer BB′ will be connected to notify the operator at B that the called subscriber's line D′ is busy. The calling subscriber is then notified of this fact and the operator will withdraw plugs CP from jack TJ and plug AP from jack J and the removal of plug CP from jack TJ will permit relay TBR to de-energize and relay TBR de-energizing opens its alternate contact 61 which causes relay IR to de-energize and relay IR de-energizing closes a circuit through the right hand winding of differential relay RR, whereupon relay RR releases and connects the interrupter INT in circuit with the secondary magnet SM, whereby magnet SM steps the wipers 47′, 49′ and 50′ to a position where they restore to normal and PON and SON also restore to normal. Switch S restoring to normal will permit the switch W to also restore to normal. If the called for subscriber's line is idle, relay SW′ will de-energize and close a circuit for relay RI, and relay RI upon energizing locks up through its upper winding and lower armature. Relay RI connects the ringing generator G^3 to the contacts of the relay CD^2 and also connects the interrupter INT′ in circuit with the winding of relay CD^2. The relay CD^2 thereupon intermittently causes a ringing current to be transmitted to the called substation D′. When the subscriber at substation D′ removes his receiver, relay SR is actuated to actuate the battery flow reversing relay RV. Relay RV reverses the connection of impulse relay IR and also causes the relay MRR to energize to disconnect the generator G^3 and interrupter INT′. Relay MRR locks itself up by way of the armature 54′ of relay RV so that if the called subscriber vibrates his switchhook, relay RV is actuated, which reverses the battery on the line for toll supervision as is well understood. The operator having her listening key LK actuated, knows when the main exchange subscriber answers, and the called subscriber at the main exchange having answered, the branch exchange operator now actuates the ring-back key RB to connect the ringing generator G′ to operate the call signal at the branch exchange substation A (the said subscriber having replaced his receiver after informing the operator of the connection wanted when he initiated the call), the subscriber at the branch exchange substation A, in response to a signal, removes his receiver,

and the subscriber at substation A and the called subscriber at the main automatic exchange are now in conversational circuit.

After conversation has terminated, the subscriber at the calling substation A replaces his receiver, opening the energizing circuit for the answering supervisory relay AS at the switchhook contacts, and the closing of normal contact 10 of the relay AS establishes a circuit for the answering supervisory lamp AL, from battery through the said lamp, normal contact 10, alternate contact 43 of the relay SL, the conductor 31 to ground at normal contact 32 of the relay SC. The operator noting the lighted supervisory signal AL, knows that conversation has terminated and withdraws the answering plug AP from the jack J of the calling line, which withdrawal opens the series energizing circuit of the cut-off relay CO and the sleeve relay SL, and the said relay SL upon de-energization opens its alternate contact 43, effacing the supervisory signal AL. The operator now withdraws the combined calling and trunk plug CP from the trunk jack TJ, which withdrawal opens the series energizing circuit of the sleeve relay SL′ and the trunk sleeve relay TSL of the trunk circuit TC. The relay TSL de-energizing, its alternate contact 45 is opened, opening the circuit of the relay TCR. The opening of alternate contact 67 of the relay TSL opens the circuit of the busy signals BS, which signals restore and again indicate that the trunk is idle. When the subscriber's substation D′ hangs up, the switches S and W, are permitted to be restored, and the release operation and restoration of the same is the same as when the called line is found busy and the operator withdraws plug CP from the jack TJ, as described above and further description at this time is thought unnecessary.

The foregoing description of the operation of the switch W and connector switch S is thought sufficient to give a clear understanding of applicant's invention, and for a more detailed statement of the operation of the switches W and S, reference is made to U. S. Patent Number 1,194,741, issued to Harry H. Ide and dated August 15, 1916.

Assuming now that the subscriber at the substation A of the branch exchange B initiates a call and wishes to converse with a manual main exchange subscriber, the operation of the cord circuit C at the branch exchange B is the same as previously described, up to and including the time that the operator at the branch exchange B inserts the plug CP into the trunk jack TJ. The insertion of the plug CP into the jack TJ closes a series energizing circuit for the relay SL′ of the cord circuit C and the relay TSL of the trunk circuit TC, and the said insertion also brings about the energization of the relay TBR, which relay TBR upon the closure of its alternate contact 47 closes an energizing circuit for the relay TCR to ground at alternate contact 45 of the relay TSL, and the closure of alternate contact 61 of the relay TBR bridges the retardation coil RE across the trunk conductors, all of which has been previously described. The bridging of the retardation coil RE to the trunk conductors will cause relay LR^4 of line circuit LC at the manual main exchange to energize over a circuit traced from battery through the winding of said relay LR^4 normal contact 101′ of relay CO^4 conductors 66^2, 66 and 65, alternate contact 61 of relay TBR, retardation coil RE conductors 63, 62 and 62^2 to ground through normal contact 102′ of relay CO^4. Relay LR^4 energizing closes its alternate contact 103′ to cause the multiple lamps 104′ to light to indicate to the operators before whom these lamps light at the manual main exchange, that a call has been initiated and demands attention.

Whereupon an operator will insert the answering plug of a cord circuit located at her position which will cause the cut off relay CO^4 to energize, whereupon relay LR^4 will restore to cause the effacement of lamps 104′. The operator's cord circuit at the main exchange may be of any of the well known two conductor type and a description of the same is thought to be unnecessary for a clear understanding of my invention.

The disconnect signaling by the calling substation A at the branch exchange B is as previously described, and the withdrawal of the plugs AP and CP from the respective jacks J and TJ brings about the restoration of the apparatus, as is readily apparent from the previous description, and the disconnection of the coil RE affects apparatus in the cord circuit at the main exchange to signal the main exchange operator.

Assuming now that the subscriber at the substation A is equipped with an impulse or calling device and wishes to converse with a main exchange subscriber at an automatic exchange, the subscriber A to initiate a call removes his receiver from the switchhook, and the operation of the circuit is the same up to and including the time that the operator actuates the listening key LK to connect her operator's set O to the cord conductor. The operator being informed that a main exchange subscriber at an automatic exchange is wanted, now inserts the calling plug CP into a trunk jack TJ and actuates the through dialing key TK. The insertion of the plug CP into trunk jack TJ closes a series energizing circuit for the sleeve relay SL′ of cord circuit C and the trunk sleeve relay TSL of the trunk circuit TC, as previously described. The actuation of the through dialing key TK disassociates the condensers 80 and 81 from the tip and ring

conductors 82 and 83 of the cord circuit C at the branch exchange B, the condenser 80 in the tip conductor 82 being disassociated due to the opening of normal contact 39 of the through dialing key TK, and the shifting of lever 84 of the key TK disassociates the condenser 81 and connects the supervisory signal control relay SC in series with the ring conductor 83. The opening of normal contacts 6 and 9 of the key TK disconnects the answering supervisory relay AS from the cord conductors, and the opening of normal contact 39 of the key TK disconnects the calling supervisory relay CS from the cord conductor. The insertion of the plug CP into trunk jack TJ closes an energizing circuit for the trunk bridging relay TBR in the trunk circuit TC and the relay SC of the cord circuit C, the circuit being traced from battery through the upper winding of the relay TBR, tip contacts of the connected jack TJ and plug CP, normal contact 34 of the relay DR, normal contact 33 of the ringing key RK, alternate contact 38 of the relay SL′, alternate contact 85 of the key TK, conductors 86 and 8, through alternate contact 4 of the relay SL, tip contacts of the connected plug AP and jack J, through the calling substation A, back through the ring contacts of the connected jack J and plug AP, through alternate contact 5 of the sleeve relay SL, conductor 7, alternate contact 84 of the key TK, through the winding of the relay SC, conductors 87, 83, through alternate contact 37 of the relay SL′, the normal contact 36 of the ringing key RK, normal contact 35 of the relay DR, ring contacts of the plug CP and trunk jack TJ, and through the lower winding of the relay TBR to ground. The relay TBR and the relay SC are thus energized over this circuit.

The closing of alternate contact 47 of the relay TBR establishes a circuit for the trunk conductor control relay TCR, from battery through the winding of the said relay TCR, conductor 48, alternate contact 47, conductor 46, to ground at alternate contact 45 of the relay TSL, and the closing of alternate contact 61 of the relay TBR bridges the retardation coil RE across the trunk conductors 62 and 63, over a circuit previously described, and the retardation coil RE being thus bridged across the trunk conductors upon the energization of the relay TBR, closes a circuit for relay LR[3] of switch W and switch W will operate to connect the conductors 62′ and 66′ to an idle connector switch S as described hereinbefore. The subscriber at the substation A now actuates the calling device to send a group of impulses to actuate the connector switch S at the main automatic exchange AM, and upon its return movement a series of impulses of a predetermined number will be sent due to interruptions at its impulse spring contacts, and upon each interruption of the impulse springs the trunk bridging relay TBR will obviously be de-energized, so that the successive interruptions of the impulse spring contacts of the calling device bring about a predetermined number of de-engizations and energizations of the relay TBR. The resulting vibrations of contact 61 of the relay TBR repeat the impulses to the impulse relay IR at main exchange and which relay IR operates to effect the operation of switch S to extend the call to the called substation D′ at the main exchange AM. Upon the first de-energization of the relay TBR, its alternate contact 47 is opened and the relay TCR of the trunk circuit TC de-energizes, and due to the construction and adjustment of its armature, it is not re-energized during the rapid vibrations of contact 47 of the relay TBR but remains in its de-energized condition. The relay SC of the cord circuit C being slow to release, is not affected by the interruptions of its circuit, due to the opening and closing of the impulse springs of the calling device.

After the last series of impulses, relay TBR will remain energized, as will also the relay SC of the cord circuit C, and also impulse relay IR of switch S, and contact 47 of the relay TBR remaining closed again energizes the trunk conductor control relay TCR, the closing of whose contacts 75 and 76 establishes the talking circuit of the trunk conductors 62 and 66 which are connected to conductors 62′ and 66′ respectively leading to the main exchange, while the opening of normal contact 75 opens the impulse bridge between conductors 62 and 66.

Upon the termination of conversation, the subscriber at the branch exchange replaces his receiver upon the switchhook, thus interrupting the circuit of the trunk bridging relay TBR of the trunk circuit TC, and the supervisory signal control relay SC of the cord circuit C at the switchhook contacts, and the opening of alternate contact 61 of the relay TBR of the trunk circuit TC opens the bridging connection of the retardation coil RE, and the trunk conductors being now conductively disunited, relay IR will deenergize and place the restoration of the automatic switches S and W under the control of the called subscriber at D′ and when subscriber at D′ replaces his receiver, relay SR restores and the switches S and W are permitted to restore to normal as hereinbefore described.

The opening of alternate contact 47 of the relay TBR opens the energizing circuit of the relay TCR, said relay TCR restoring. The relay SC restoring closes its normal contact 32, establishing circuits for the calling and answering supervisory signals CL and AL, over circuits as previously described, and the two signals being lighted over these

circuits informs the operator that conversation has been completed, and the withdrawal of the plug AP from the jack J de-energizes the cut-off relay CO and the sleeve relay SL, and the withdrawal of the plug CP from the trunk TJ opens a series energizing circuit for the sleeve relay SL′ and the trunk sleeve relay TSL. The operator also restores the through trunking key TK to normal, and the apparatus used in establishing the connection just described is now at normal and available for use in establishing other connections.

The branch exchange B may also receive calls from either a common battery manual or automatic main exchange, and when a call is extended to the branch exchange B, ringing current transmitted from the main exchange passes through the ring-down relay RR, which is bridged across the trunking conductors, and the relay RR being thus energized attracts its armature, which is of the mechanical locking type and locks in its attracted position.

The closure of alternate contact 90 establishes an energizing circuit for the trunk signal SI, traced from battery through the said alternate contact 90, conductor 91, normal contact 92 of the relay TSL, through the signal SI to ground. The trunk signal SI is lighted, and the operator noting the lighted lamp inserts the calling plug CP into the trunk jack TJ associated with the lighted lamp, closing a series energizing circuit for the sleeve relay SL′ of the cord circuit C and the trunk sleeve relay TSL of the trunk circuit TC, and the insertion of the said plug CP into trunk jack TJ also closes energizing circuits for the trunk bridging relay TBR of the trunk circuit TC and the calling supervisory relay CS of the cord C over the circuit as previously described. The closing of alternate contact 47 of the relay TBR closes an energizing circuit for the relay TCR, and the relay TCR upon energization, through means of a suitable latch, releases the locked armature of relay RR, and the opening of alternate contact 90 of relay RR effaces the signal SI. The closing of alternate contact 61 of the relay TBR of the trunk circuit TC bridges the retardation coil RE across the trunk conductors, which affects the apparatus at the main exchange, should the call be from a manual exchange, to signal the operator thereat that the branch exchange operator has answered; or, in case the call has been extended from a main automatic exchange (by means of a connector applied to the multiple terminals of trunk TC there), the retardation coil is bridged across the trunk conductors and holds the line circuit equipment used in connection with the trunk circuit in the same way as if a called automatic subscriber had answered, and the branch exchange operator to complete connection inserts the answering plug AP into the jack J and signals the called branch exchange substation by actuating the ringback key RB. Disconnection after conversation is the same as previously described, and further description is not necessary.

While I have illustrated and described a particular embodiment of my invention, it is to be understood that I do not intend to be limited to the exact structure as herein illustrated and described, but intend to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a trunk circuit having directive impulse-controlled mechanism at its distant end, said trunk circuit connected with said cord circuit, an operator's impulse device, supervisory signal means for said cord circuit, a relay for said cord circuit, contact means controlled by said device for changing the operative condition of said relay while said device is actuating, and a contact of said relay in circuit with said means.

2. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism at its distant end, said link circuit connected with said cord circuit, an operator's impulse device in said cord circuit, an inductive bridge across said link circuit, a relay for said link circuit, said device adapted to cause the operative condition of said relay to be changed while said device is actuating, and a contact of said relay in circuit with said bridge.

3. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism at its distant end, said link circuit connected with said cord circuit, an operator's impulse device in said cord circuit, an inductive bridge across said link circuit, a relay for said link circuit, its operative condition caused to be changed by said device while said device is actuating, and switch means controlled by said relay to establish a non-inductive bridge across said link circuit.

4. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism

at its distant end, said link circuit connected with said cord circuit, an operator's impulse device in said cord circuit, an inductive bridge across said link circuit, a relay for said link circuit, its operative condition caused to be changed by said device while said device is actuating, a contact of said relay in circuit with said bridge, and switch means controlled by said relay to establish a non-inductive bridge across said link circuit.

5. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism at its distant end, said link circuit connected with said cord circuit, an operator's impulse device, supervisory signal means for said cord circuit, a relay for said cord circuit, its operative condition changed by said device while said device is actuating, a contact of said relay in circuit with said supervisory signal means, an inductive bridge across said link circuit, a relay for said link circuit, its operative condition changed by said device while said device is actuating, and a contact of said relay in circuit with said bridge.

6. A telephone system including telephone lines, an operator's cord circuit for use in interconecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism at its distant end, said link circuit connected with said cord circuit, an operator's impulse device, supervisory signal means for said cord circuit, a relay for said cord circuit, said device adapted to cause the operative condition of said relay to be changed while said device is actuating, a contact of said relay in circuit with said means, an inductive bridge across said link circuit, a relay for said link circuit, its operative condition changed by said device while said device is actuating, and switch means controlled by said last relay to establish a non-inductive bridge across said link circuit.

7. A telephone system including telephone lines, an operator's cord circuit for use in interconnecting them, said cord circuit connected with a calling line, a link circuit having directive impulse-controlled mechanism at its distant end, said link circuit connected with said cord circuit, an operator's impulse device, supervisory signal means for said cord circuit, a relay for said cord circuit, its operative condition changed by said device while said device is actuating, a contact of said relay in circuit with said means, an inductive bridge across said link circuit, a relay for said link circuit, its operative condition changed by said device while said device is actuating, a contact of said last relay in circuit with said bridge, and switch means controlled by said last relay to establish a non-inductive bridge across said link circuit.

8. A telephone system including a subscriber's line, a trunk circuit terminating before a plurality of operators' positions and provided with directive impulse adjusted means at its far end, an operator's link circuit connecting said line and said trunk, supervisory means for indicating the idle or busy condition of said trunk circuit, a directive impulse device at the substation of said line, an operator's switching key in said link circuit to operatively associate said device and said trunk circuit to render said trunk responsive to said device, signal means for said link circuit sensitive to the opening of the line at the substation, and a switch actuated on the association of said device and said trunk to render said means insensitive to momentary opening of the line at the substation.

9. A telephone system including a subscriber's line, a trunk circuit terminating before a plurality of operators' positions and provided with directive impulse adjusted means at its far end, an operator's link circuit connecting said line and said trunk, supervisory means for indicating the idle or busy condition of said trunk circuit, a directive impulse device at the substation of said line, an operator's switching key in said link circuit to operatively associate said device and said trunk circuit to render said trunk responsive to said device, a relay for said trunk to adjust its connections for impulse transmission, an impulse relay for said trunk responsive to said device, and a circuit for said first relay controlled by said second relay.

10. A telephone system including a subscriber's line, a trunk circuit with directive impulse adjusted means at its far end, an operator's link circuit connecting said line and said trunk, a directive impulse device at the substation of said line, an operator's switching key in said link circuit to operatively associate said device and said trunk circuit to render said trunk responsive to said device, an impulse relay for said trunk responsive to said device, an inductive resistance bridged across said trunk circuit, and switch means controlled by said impulse relay to shunt said resistance while said relay is actuating.

11. A telephone system including a subscriber's line, a trunk circuit terminating in a plurality of operators' positions and provided with directive impulse adjusted means at its far end, an operator's link circuit connecting said line and said trunk, a directive impulse device at the substation of said line, an operator's switching key in said link circuit to operatively associate said device and said trunk circuit to render said trunk responsive to said device, signal means for

said link circuit sensitive to the opening of the line at the substation, a switch actuated on the association of said device and said trunk to render said means insensitive to momentary opening of the line at the substation, a relay for said trunk to adjust its connections for impulse transmission, an impulse relay for said trunk responsive to said device, and a circuit for said first relay controlled by said second relay.

12. A telephone system including a subscriber's line, a trunk circuit terminating in a plurality of operators' positions and provided with directive impulse adjusted means at its far end, an operator's link circuit connecting said line and said trunk, a directive impulse device at the substation of said line, an operator's switching key in said link circuit to operatively associate said device and said trunk circuit to render said trunk responsive to said device, signal means for said link circuit sensitive to the opening of the line at the substation, a switch actuated on the association of said device and said trunk to render said means insensitive to momentary opening of the line at the substation, an impulse relay for said trunk responsive to said device, an inductive resistance bridged across said trunk circuit, and switch means controlled by said impulse relay to disconnect said resistance while said relay is actuating.

13. A repeater trunk circuit for telephone exchanges having a spring jack at one end and directive impulse mechanism at the other, an operator's plug terminal for connection with said spring jack, said trunk having a pair of relays energized on connection made between said plug terminal and said spring jack, one of said relays operable responsive to directive impulses transmitted over a plug and jack contact, a third relay energized by the energization of said two relays, an impulse transmitter for vibrating the one of said pair of relays while the other remains energized, said third relay de-energized during such vibration, and contact connections between the limbs of said trunk circuit controlled by the energization and de-energization of said third relay.

14. A telephone system including a trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said calling line, operator's switching means in said link circuit for connecting either device operatively with said trunk line, a signal for said link circuit, and a relay operated to change the connections of said signal when said operator's impulse device is connected as aforesaid.

15. A telephone system including a trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said calling line, operator's switching means in said link circuit for connecting either device operatively with said trunk line, a signal for said link circuit, and a relay operated to change the connections of said signal when the substation impulse device is connected as aforesaid.

16. A telephone system including a trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said calling line, operator's switching means in said link circuit for connecting either device operatively with said trunk line, a signal for said link circuit, a relay in said link circuit operated to change the connections of said signal when said operator's impulse device is connected as aforesaid and operated, and a relay operated to change the connections of said signal when the substation impulse device is connected as aforesaid.

17. A telephone system including a trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said line, operator's switching means in said link circuit for connecting either device operatively with said trunk line, a signal for said link circuit, a relay operated to change the connections of said signal when said operator's impulse device is connected as aforesaid, a relay in said trunk line energized upon connection of said link circuit and line, and a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses.

18. A telephone system including a trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said line, operator's switching means in said link circuit for connecting either device operatively with said trunk line, a signal for said link circuit, a relay operated to change the connections of said signal when the substation impulse device is connected as aforesaid, a relay in said trunk line energized upon connection

of said link circuit and line, and a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses.

19. A telephone system including a two way trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, an impulse device at the substation of said line, operator's switching means for connecting either device operatively with said trunk line, a signal for said link circuit, a relay operated to change the connections of said signal when said operator's impulse device is connected as aforesaid, a relay operated to change the connections of said signal when the substation impulse device is connected as aforesaid, a relay in said trunk line energized upon connection of said link circuit and line, a connection controlled by each impulse device to de-energize said relay, and an impulse bridge across said trunk line effective when said last relay is inert.

20. A telephone system including a two way trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, a relay in said trunk line energized upon connection of said link circuit and line, and a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses.

21. A telephone system including a two way trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an impulse device at the substation of said line, a relay in said trunk line energized upon connection of said link circuit and line, and a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses.

22. A telephone system including a two way trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an operator's impulse device at said link circuit, a signal for said link circuit, a relay operated to change the connections of said signal when said operator's impulse device is connected as aforesaid, a relay in said trunk line energized upon connection of said link circuit and line, and a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses.

23. A telephone system including a two way trunk line having a manually operated connection terminal at one end and directive impulse mechanism at the other end, an operator's link circuit connecting a calling line with said terminal, an impulse device at the substation of said line, a signal for said link circuit, a relay operated to change the connections of said signal when the substation impulse device is connected as aforesaid, a relay in said trunk line energized upon connection of said link circuit and line, a connection controlled by said impulse device to de-energize said relay for the transmitting of impulses, and an impulse bridge across said trunk line effective when said last relay is inert.

24. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, and switch means controlled by said impulse relay to prevent the display of said signal.

25. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, an impedance bridged across said trunk by said relay, a shunt for said impedance, and a second relay responsive only to a steady energization of said impulse relay to render said shunt ineffective and said impedance effective.

26. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, an impedance bridged across said trunk, a shunt for said impedance, a second relay responsive only to a steady energization of said impulse relay to render said shunt ineffective and said impedance effective, and switch means controlled by said second relay to prevent the display of said signal.

27. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, a second relay responsive only to a steady energization of said impulse relay, and a switch contact in the talking circuit of said trunk controlled by said second relay.

28. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, an impedance bridged across said trunk via a contact of said impulse relay, a shunt for said impedance, a second relay responsive only to a steady energization of said impulse relay to render said shunt ineffective, and a switch contact in the talking circuit of said trunk controlled by said second relay.

29. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, an impedance bridged across said trunk, a shunt for said impedance, a second relay responsive only to a steady energization of said impulse relay to render said shunt ineffective, and means controlled by said second relay to prevent the display of said signal.

30. A telephone system including a manual exchange and an automatic exchange, a two-way trunk for connecting lines of subscribers in either exchange with those of subscribers in the other, an impulse relay in said trunk at the manual exchange sensitive to directive impulses for extending outgoing calls from the manual exchange, a signal in said trunk at the manual exchange responsive to current from the automatic exchange to signal an incoming call therefrom, an impedance bridged across said trunk by said impulse relay, a shunt for said impedance, a second relay responsive only to a steady energization of said impulse relay to render ineffective said shunt, a switch contact in the talking circuit of said trunk controlled by said second relay, and means controlled by said second relay to prevent the display of said signal.

31. A telephone system including a two-way trunk between a manual and an automatic exchange, said trunk provided at the manual exchange with a single wound relay establishing the talking circuit of the trunk in one operated position and the impulse transmitting circuit thereof in the other operated position, an impulse relay controlling said first relay, a signal at the manual exchange, a circuit for said signal, said circuit including a contact of said first relay.

32. A telephone system including a two-way trunk between a manual and an automatic exchange, said trunk provided at the manual exchange with a relay establishing the talking circuit of the trunk in one operated position and the impulse transmitting circuit thereof in the other operated position, an impulse relay controlling said first relay, and a circuit to signal an operator at the manual exchange, said circuit including a contact of said first relay.

33. A telephone system including a two-way trunk between a manual and an automatic exchange, said trunk provided at the manual exchange with a single wound relay establishing the talking circuit of the trunk in one operated position and the impulse transmitting circuit thereof in the other operated position, means including a plug and jack contact and an impulse relay for controlling said first relay, and a circuit to signal an operator, said circuit including a contact of said first relay.

34. A telephone system including a two-way trunk between a manual and an automatic exchange, said trunk provided at the manual exchange with a relay establishing the talking circuit of the trunk in one operated position and the impulse transmitting circuit thereof in the other operated position, and a circuit to signal an operator, said circuit including a contact of said first relay.

35. In a telephone system, a link circuit having an inductive bridge across it, a relay for closing a shunt about said bridge while directive impulses pass over said circuit and to open said shunt again thereafter, directive impulse adjusted switch mechanism at one end of said circuit to receive incoming calls over said circuit from one direction, and mechanism at the other end of said circuit to receive incoming calls over said circuit from the opposite direction.

36. A telephone system including a two-way trunk having directive impulse adjustable means associated with one end and

visual signal means at the other end, an inductive bridge normally across said trunk at said other end, and electrically operated means for rendering said bridge ineffective during the transmission of directive impulses.

37. In a telephone system, a link circuit having normally an inductive bridge across it, a relay for closing a shunt about said bridge to clear said circuit for the transmission of directive impulses, said relay actuated to open the shunt after each impulse set transmitted, and visual signal means operatively associated with said bridge.

38. A telephone system including a subscriber's line, a link circuit with directive impulse adjustable means at its far end, said circuit connected with said line, an impulse device at the substation of said line, a relay for said link circuit to adjust its connections for impulse transmission, an inductive bridge normally across said circuit and controlled by said relay, and an impulse relay controlling said first relay.

39. A telephone system including telephone lines, a link circuit for interconnecting them and connected with one of said lines, a second link circuit connected with the first line and provided with directive impulse adjustable apparatus, an impulse device for transmitting impulses over said first circuit to the second line an inductive bridge across said second circuit, a relay for said second circuit, its operative condition changed during the actuation of said device, and a contact of said relay connected with said bridge.

40. A telephone system including subscribers' lines and a link circuit for use in interconnecting them having directive impulse adjusted mechanism at one end, an operator's directive impulse device, a relay in said link circuit energized on connection of said link circuit and said line, an impulse relay and a connection controlled by said impulse device to de-energize said relay while said impulse relay is vibrating.

41. A telephone system including two exchanges, a two-way trunk for use in interconnecting subscribers of the two exchanges for conversation, an impulse transmitting circuit for said trunk, said trunk provided at one exchange with a relay establishing the talking circuit of the trunk in one operated position and the impulse transmitting circuit thereof in another, an impulse relay at said exchange controlling said first relay, apparatus at said exchange for receiving calls from the other exchange, an inductive bridge across said trunk, and a connection controlled by said first relay for placing a shunt about said inductive bridge during the transmission of impulses.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 4th day of May, 1921.

ELMER W. LINCOLN.