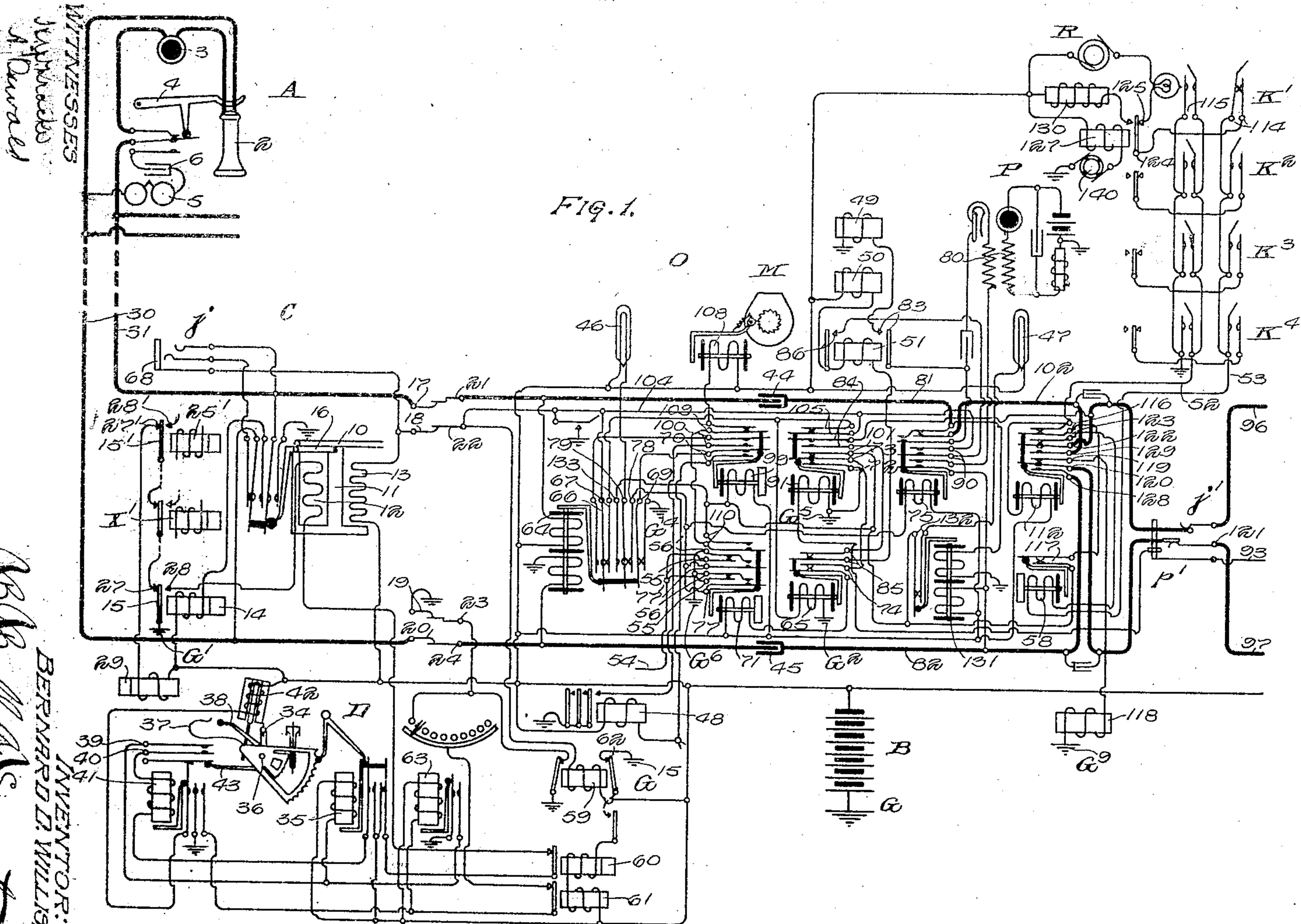


1,293,597.

B. D. WILLIS.
TELEPHONE SYSTEM.
APPLICATION FILED NOV. 28, 1913.

Patented Feb. 4, 1919.
2 SHEETS—SHEET 1.

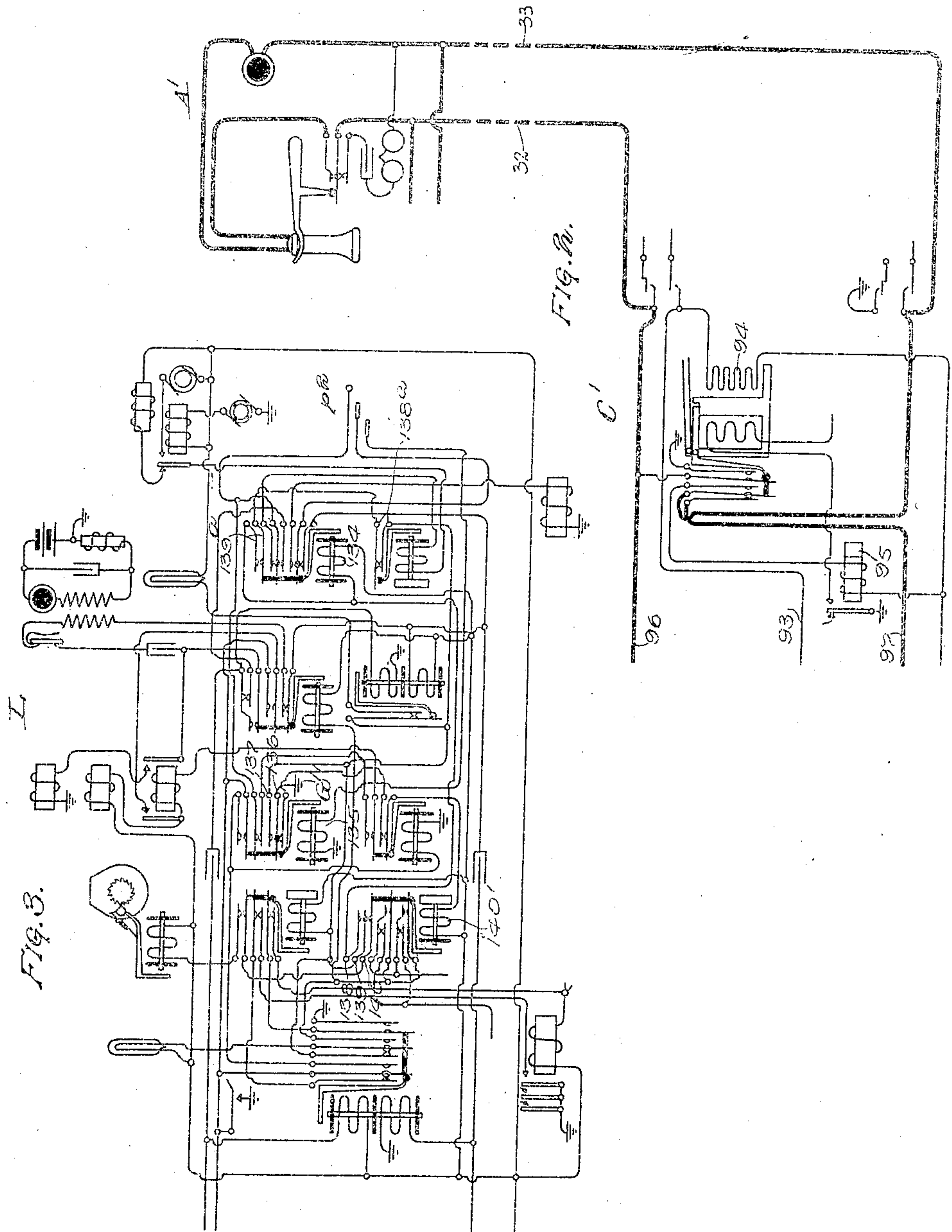


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TELEPHONE SYSTEM.

1,293,597.

Specification of Letters Patent.

Patented Feb. 4, 1919.

Application filed November 28, 1913. Serial No. 803,531.

To all whom it may concern:

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

My invention relates to improvements in telephone systems, and more particularly to automatic or semi-automatic systems—that is, systems in which a connection is established in whole or in part through the medium of automatic switches.

One of the features of my invention relates to a system employing line switches controlled by a master switch for selecting idle trunks. In such a system I provide means for preventing two or more subscribers who have removed their receivers from the switch-hooks while the master switch is rotating to move the line switches of a group opposite an idle trunk from connecting with the same trunk after the master switch stops.

Furthermore, I provide means whereby, if two or more subscribers have removed their receivers from the switch-hooks while the master switch is rotating, the line switches on these subscribers' lines will connect with separate trunks.

A further feature of my invention is the provision of means for giving an operator in a semi-automatic or manual system a discriminating busy test—that is, enable her to distinguish between a busy test obtained from testing the multiple jack of the calling subscriber's line which is connected to the answering end of the operator's cord circuit, and a busy test obtained from testing the jack of some other subscriber's line.

A further feature of my invention is the provision of improved means for disconnecting the ringing current from the called subscriber's line as soon as the called subscriber removes his receiver from the hook. Heretofore, when the ringing current was intermittently applied, this current could only be disconnected during the interruptions of the ringing current. By my invention, however, the ringing current is disconnected immediately upon the response of the called subscriber, regardless of whether or not the ringing current is at that time connected with the line.

These and other objects of my invention

will be more readily understood by reference to the accompanying drawings, in which I have illustrated one embodiment of my invention in connection with a semi-automatic system employing line switches of a well-known type and an operator's cord circuit.

Figures 1 and 2 taken together show a complete circuit connection between a calling substation A and a called substation A' embodying the principles of my invention. The connection is completed through the medium of the individual switch C, cord circuit O and the called subscriber's individual switch C' to the substation A'.

Fig. 3 shows a modified form of cord circuit.

Referring to Fig. 1, the line conductors 30 and 31 of the subscriber's substation A terminate in the individual or line switch C. The line switch shown at C is one of a group of similar line switches the plungers (not shown) of which engage a shaft and are controlled by the operation of the master switch shown at D in such a manner that they are, when in normal position, held directly in front of the terminals of a trunk line leading to an idle cord circuit O. The cord circuit O is equipped with the necessary apparatus for completing connection with any one of a plurality of substations (only one of which is shown) connected to the line conductors 32 and 33 (Fig. 2) through the medium of the line switch C'. Although there is shown only one substation A' connected to the line conductors 32 and 33, it will be understood that a plurality of like substations may be connected to the said lines. The ringers of the different substations may be arranged in any well-known manner to respond to the ringing current generated by some particular one of a plurality of generators.

The subscriber's substation A is of any suitable or approved type and comprises the usual receiver 2, transmitter 3, switch-hook 4, ringer 5 and condenser 6. The line conductors of the said substation terminate in the central exchange in a line switch C. Associated with the said line conductors and with the individual switch C is the multiple jack J, through which connections are extended to the substation A.

The primary line switch C is of the gen-

eral type of line switch shown in British patent to R. W. James No. 26,301 of 1906, the particular form shown, however, being similar to that shown in British patent to T. G. Martin No. 1419 of 1910, with the exception that the line relay and operating magnets are made separate instead of being combined in a single structure. Among other details, the line switch comprises a plunger (not shown) carried upon the end of the plunger arm 10 which is adapted, when the plunger arm is attracted by the magnet 11, to force the plunger into a bank of contact springs, forcing the springs 17, 18, 19 and 20 into engagement with the springs 21, 22, 23 and 24, respectively. The magnet 11 also controls the cut-off armature 16 and comprises two windings, namely, the pull-in winding 12 and the cut-off or holding winding 13. The winding 12 is strong enough to operate both the plunger arm 10 and the cut-off armature 16, while the winding 13 is only strong enough to operate the cut-off armature 16 and to hold the plunger arm 10 in an operated position after it has once been drawn in by the winding 12. The line relay 14 is slow acting—that is, slow to deenergize after its energizing circuit has been broken, so that it may keep the operating winding 12 energized for a short time after the cut-off armature 16 has operated to disconnect said line relay 14 from the line. Although only one set of springs (17–24 inclusive) is shown, each line is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a cord circuit similar to O. Each trunk line is connected in multiple with the corresponding springs of all the switches of the group which is controlled by the master switch D. The switch C is controlled by the subscriber through the medium of the line relay 14, as will be hereinafter more fully explained. The line switch C is assumed to be the first line switch of the group of line switches controlled by the master switch D, while the relay 25 is likewise assumed to be the line relay of the last line switch of said group. When all of the line relays of the switches of the group are at normal, a circuit extends from ground G' through the contact of the springs 15 and 27 of each line switch and through the high resistance supervisory relay 29 to battery B. If the line relay 14 of the line switch C should be energized, the circuit closed by the said chain of relays will be interrupted at the springs 15 and 27 of said relay, thus making it impossible for the pull-in winding of any other line switch of the group to be energized until the said line relay deenergizes. In other words, the line switch C (which is line switch number 1 of the group) controls the operating circuits of all the other line switches of the group. The line relay of line switch number 2 of the group controls

the operating circuits of all the other line switches of the group, except line switch number 1, which is nearer the operating ground G'. This is true of all the other line switches of the group, i. e., each line switch controls the operating circuits of all the other line switches of the group between it and the last line switch in the said group. The purpose of this feature is, should the subscriber A to whom the line switch C belongs initiate a call and start the master switch D to search for an idle trunk line, and should several other subscribers take off their receivers, and thus energize the line relay of their respective line switches, while the master switch is rotating, it will be impossible for all of them to plunge in upon the same trunk line when the master switch comes to rest. The one nearest the operating ground G' will plunge in and break the operating circuits of the other line switches a sufficient length of time for the master switch D to find another idle trunk line, and then the next nearest line switch to the operating ground will operate, etc. The plungers of the line switches are preferably of the self-aligning type, i. e., they always return to locking engagement with the master switch shaft when they become idle.

The master switch D is of the same general type as that disclosed in British Patent No. 26,301 of 1906, referred to above, being, however, of the particular type disclosed in French Patent No. 339,234 of 1912, the circuits, however, being somewhat modified to operate in a system embodying the principles of my invention. In general, the operation of the master switch is as follows: Whenever a line switch whose plunger is in engagement with the plunger shaft 34 is operated to seize an idle trunk line, the relay 35 is energized to unlock the shaft 36. The spring 37 thereupon begins to rotate said shaft to cause the plunger shaft to move the idle plungers away from the trunk line just seized and onto an idle trunk line. When the idle trunk line is reached, the relay 35 deenergizes and again locks the plunger shaft. When the plungers in their operation pass beyond the last trunk line, the arm 38 forces the spring 39 into engagement with the spring 40, whereupon the relay 41 is energized and closes the circuit of the solenoid 42. The solenoid, upon energizing, rotates the shaft 36 back to its initial position, so as to bring all the plungers which are in engagement with the plunger shaft back to a position opposite the first trunk line and to restore the tension of the spring 37. When the plunger shaft reaches its initial position, the arm 43 unlocks the springs of the relay 41, which permits the solenoid to deenergize and the plunger shaft to come to rest. A relay 39 is associated with each trunk line leading from the group of line

switches to which the line switch C belongs. The relay 59 is energized whenever its corresponding trunk is in use. When all the trunks leading from said group become busy at one time, and therefore all the relays 59 energized, the relays 60 and 61 become energized over the following circuit: from ground G^{15} through the contact of springs 62 of each trunk relay 59 and through the said relays 60 and 61 to battery B. The relay 60, upon energizing, removes battery from the pull-in windings of all the line switches of this group. The relay 61, upon energizing, opens the circuit of the start relay 63 of the master switch D, so that said master switch will not operate until a trunk line becomes idle.

The trunk line seized by the switch C terminates in the cord circuit O, through the medium of which the circuit is completed to the called line. The two ends of the cord circuits are connected together through the medium of the condensers 44 and 45. The cord circuit is also provided with the usual calling and answering supervisory signals 47 and 46 and the necessary relays for controlling the same. The relay 48 is a group busy signal, i. e., it is a relay to make all trunks to an operator's position busy as long as there is an uncompleted connection at said operator's position. The relay 48 may be common to all the cord circuits of an operator's position.

The meter M is the means for registering all calls handled by one operator. The relays 49, 50 and 51 furnish means for giving a discriminating busy test whereby the operator can ascertain whether she is testing a multiple jack of the calling line connected to the answering end of the cord, or of some other busy line. Multiplied through the springs 55 and 56 and 55' and 56' of every cord circuit common to an operator's position there is a conductor 54, the function of which is to prevent the operator's head set P being connected to more than one cord circuit at a time, if it so happened that more than one call was successful in reaching an operator's position at one time. The keys K^1 , K^2 , K^3 and K^4 are the means by which any one of a plurality of generators (only one shown) may be connected to the cord circuit O for signaling purposes. The said keys are so arranged that when any one of these keys is depressed, any other depressed key will be mechanically restored to normal, so as not to allow two generators to be connected to the conductors 52 and 53 at one time. The connection of the ringing current to the called line is controlled by the ringing relay 112, which is energized when any one of the keys K^1 , K^2 , K^3 or K^4 is operated. Connected in series with the ringing circuit is a relay 58 so constructed and adjusted that it will not operatively en-

ergize when ringing current from the generator R is transmitted through it to the called substation and through the condenser at the called substation to ground, but the instant the receiver is removed at the called substation and the substation talking set is bridged across the line, the said relay 58 will receive sufficient current through the battery B in series with the generator R to operatively energize.

The line switch C' and the substation A' are similar in all respects to the line switch C and the substation A.

The cord circuit L (Fig. 3) is similar to the cord circuit O except that the ringing of the called substation is started automatically by the operator plugging into the multiple jack of the called substation.

Having given a general description of the apparatus involved in the system, in order to give a complete understanding of my invention it will be described how the subscriber at the substation A may obtain connection with the subscriber at the substation A'. When the receiver at the substation A is removed from the switch-hook preparatory to making a call, the engagement of the hook-switch springs completes a bridge across the line through the receiver and transmitter of the substation. The closure of this bridge across the line establishes an energizing circuit for the line relay 14 of the line switch C. The relay 14, upon energizing, operates to close the circuit of the operating winding 12 of the magnet 11, which, upon energizing, attracts the plunger arm 10 and the cut-off armature 16, whereby the line conductors 30 and 31 are extended through the line switch bank springs 17 and 21 and 20 and 24 to the cord circuit O, and the line relay 14 is disconnected from the line. When the connection is extended to the said cord circuit O, the line relay 64, which is normally bridged across the line circuit of the cord O in series with the battery, becomes energized and operates to close the circuit of the holding winding 13 of the line switch C before the line relay 14 deenergizes. It also operates to close the circuit of the trunk relay 59. The circuit for the holding winding 13 of the switch C extends from ground G^2 through the relay 65, contact of springs 67 and 66 of the relay 64, bank springs 22 and 18 and the said holding winding 13 to battery B. The circuit for the relay 59 extends over the same circuit as far as the bank springs 22 and from there it passes through the relay 59 to battery B. A guarding ground potential is also supplied to the bush 68 of the multiple jack j to make the calling line test busy. The closing of the bank springs 19 and 23 causes the master switch D to operate in a well-known manner to move the plungers of all the idle line switches opposite the next idle trunk line. A further result of the ener-

gization of the line relay 64 is to close a circuit through the group busy relay 43. This circuit extends from ground G² through the contact of springs 69, springs 70 and the relay 43 to battery B. The relay 43, upon energizing, operates to place a guarding potential upon every idle trunk line leading to the operator's position. The relay 63, upon energizing over the circuit for the holding winding 13 above traced, closes a circuit through the slow acting relay 71. This circuit extends from ground G² through the contact of springs 73 and 72, springs 74 and the relay 71 to battery B. The relay 71, upon energizing, closes a circuit through the line signal lamp 46 and the relay 75. The circuit for the line signal lamp extends from ground G² through the springs 56, 77, and 56', 77' in parallel, springs 78 and 79 and the said lamp 46 to battery B. The circuit for the relay 75 extends from ground G² through the springs 56, 77, and 56', 77' in parallel and through the said relay 75 to battery B. The relay 75, upon energizing, connects the operator's head set across the conductors 81 and 82. A further result of the energizing of the relay 71 is to disconnect ground from the conductor 54 which multiplies through all the other cord circuits of the operator's position, thus making it impossible for the line signal lamp 46 or the relay 75 (which connects the operator's head set with the cord circuit) of any other cord circuit to operate. This is accomplished in the following manner: Relay 71, being energized, remains in that condition until the operator plugs into a jack to complete the call, as will be hereinafter explained. It is therefore obvious that there is no ground on springs 55 and 55' which lead to the conductor 54. Conductor 54 now multiplies to corresponding springs 55 and 55' in the remaining cord circuits associated with the operator's position. It is therefore evident that when a call is directed over any other cord circuit it can proceed as far as and energize its relay 71. However, there being no ground on the corresponding springs 55 and 55' associated with its cord circuit, therefore, when the springs corresponding to 77-55 and 77'-55' are in contact, there is no ground supplied to energize the relay 75. The relay 75 must be energized to complete a connection through to the operator's headset. Therefore, it is evident that only one sub-station can be in connection with the operator's headset at one time.

The operator, upon noticing the line signal lamp 46 glowing, inquires of the calling subscriber the number desired. We will assume that it is substation A', whose bells are so arranged as to respond to the ringing current from the generator R. The operator touches the tip of the plug P' to the bush of the jack j'. If the line is busy, the relay 61

associated with the cord circuit O will immediately energize and cause the springs 83 to engage, thus giving the operator a click in the ear. The energizing circuit for the relay 51 extends from ground upon the bush of the jacks j' through the tip of the plug p', the contacts of spring 84, springs 85, relay 51 and the coil 50 to battery B. The operator immediately informs the calling subscriber that the line is busy or plugs the plug p' into a special busy jack (not shown), giving the calling subscriber a busy signal. If the substation desired is a substation upon the calling subscriber's line, when the operator touches the plug p' to the bush of the jack j, the relay 51 will act as a buzzer, due to the fact that the said relay short-circuits itself at the springs 86 every time it energizes. The short-circuit for the said relay may be traced from the bush of the jack j through the bank springs 18 and 22, springs 90, springs 86, relay 51, springs 85, springs 84, the tip of the plug p' to the bush of the jack j. The buzzing effect of the relay 51 notifies the operator that the substation desired is one upon the calling substation line and she will immediately proceed to complete the connection.

Assuming that the line desired is idle, the operator immediately plugs the plug p' into the jack j', which causes the relay 51 to immediately pull up. The circuit for the relay 91 extends from ground G² through the relay 91, sleeve of the plug p', bush of the jack j', conductor 93 and the cut-off winding 94 of the line switch C' to battery B. The cut-off winding, upon energizing, disconnects the line relay 95 from the line and completes the connection through to the substation A'. The relay 91, upon energizing, breaks the circuit of the relay 71 at the springs 72 and 73 and closes a circuit through the relay 99 and supervisory lamp 47 at the springs 73 and 101. A further result due to the energization of the relay 91 is to disconnect the relays 51 and 50 from the conductor 102 at the springs 84, and to connect a holding ground to the trunk-release conductor 104 through the springs 105 independent of the springs 67 and 68 of the line relay 64. The relay 99, upon energizing, opens the circuit of the group busy relay 43 at the springs 70 and closes a circuit through the meter control magnet 108 at the springs 109, the circuit of said magnet being opened an instant later at the springs 110, when the relay 71 de-energizes. The relay 71, upon deenergizing, opens the circuit of the relay 75 at the springs 77, 56 and 77', 56' in multiple, thus disconnecting the operator's head set from the cord O. The operator's position is now in readiness to receive another call.

The operator now presses the key K' to connect the generator R with the called line.

The key K' locks in its depressed position (holding the contact of springs 114 closed, but allowing the springs 115 to close and then separate) and mechanically restores the key previously operated to normal. The relay 112 is energized as soon as the key K' is depressed and operates to close a locking circuit for itself through the springs 116 independent of the springs 115 at the key K'.

The said locking circuit extends from ground G⁵ through the contact of springs 73 and 101 of the relay 91, springs 117 of the relay 58, springs 116 and the said relay 112 to battery B. A further result of the energization of the relay 112 is to disconnect the calling line from the called line and to connect the generator to the called line over the following path: from ground G⁰ through the coil 118, contact of springs 119 and 120, ring contact of the plug p', spring 121 of the jack j', conductor 97 to and through the substation A', conductor 96, tip spring of the jack j', tip of the plug p', springs 122 and 123, relay 58, springs 114 of the key K', springs 124 and 125 (when the interrupter relay 127 is deenergized) and the generator R through the battery B to ground G. The springs 122 and 129 and the springs 120 and 128 are shunted by a very high resistance, or by a very small condenser. This allows a very small portion of the ringing current to be transmitted back through the calling line to the calling substation, thus giving the calling subscriber an audible ringing signal, informing him that the called subscriber is being signaled. I have found that the high resistance may be merely a line drawn by a carbon pencil on the insulating mounting between the said springs, or the condenser may be the capacity effect of a pair of insulated wires twisted together, one wire electrically connected to one spring and the other wire connected to the other spring. Either gives very satisfactory results. The called subscriber is signaled intermittently through the medium of the interrupter 140 and the interrupter relay 127. Should the called subscriber answer during the ringing period, the bridging of the substation talking set across the line would cause the relay 58 to receive sufficient current through the battery and generator in series to operatively energize. The relay 58, upon energizing, opens the locking circuit of the relay 112 at the springs 117. The relay 112, upon deenergizing, disconnects the generator from the called line and connects the calling line with the called line over the heavy conductors shown and bridges the relay 131 across the called line. The relay 131, upon energizing, opens the circuit of the supervisory lamp 47 at the springs 132. Should the called subscriber answer during the time that the interrupter relay 127 is energized, the relay 58 would receive sufficient current

through the coil 130 to operatively energize and perform the same operations as above described.

The replacing of the receivers at the called and calling substations signifies to the operator that the conversation is terminated. When the receiver at the substation A is restored to the switch-hook, the separation of the hook springs destroys the energizing circuit of the line relay 64. The relay 64, upon deenergizing, causes the supervisory lamp 46 to glow over the following circuit: from ground G⁵ through the springs 73 and 101, springs 133 and 79 and the said lamp to battery B. The replacing of the receiver at the called substation A' opens the circuit of the relay 131. The relay 131, upon deenergizing, closes a circuit through the supervisory lamp 47 over the following path: from ground G⁵ through the springs 73 and 101, springs 132 and the said lamp to battery B. The operator, upon receiving the disconnect signal, removes the plug p' from the jack j', thus breaking the circuit of the relay 91 and the bridge-cut-off winding 94 of the line switch C'. The relay 91, upon deenergizing, opens the circuits of the relays 99 and 65, removes the holding ground from the holding winding 13 of the line switch C and opens the circuits of the supervisory lamps 46 and 47. The holding winding of the line switch C, upon deenergizing, allows the line switch plunger to be returned to normal. The relay 99 is preferably made slow acting so that the line switch C is given sufficient time to return to normal before the private conductor 104 is again connected to the group busy relay common to the various other cord circuits.

The cord circuit L (Fig. 3), as hereinbefore stated, is similar to the cord circuit O, with the exception that the ringing is started automatically and not by means of a key. When a connection is established between the substation A and a called substation not shown, which may be similar to the substation A', by means of this cord circuit L, the operation of the line switch C and the cord circuit L is the same as for the line switch C and the cord circuit O up to the time when the operator plugs the plug p² into the multiple jack of the called substation. When this operation takes place, the relay 135 energizes, as hereinbefore stated, with the same results as before described and with the additional result of causing the relay 134 to energize, which, in the previous cord circuit, was energized by the pressing of the key K'. The energizing circuit for the relay 134 extends from ground G¹¹ through the contact of springs 136 and 137, springs 139^a and 138^a and the said relay 134 to battery B. The relay 134, upon energizing, performs the same functions as hereinbefore described and locks itself up over a

circuit extending from ground G^{11} through the contact of springs 136 and 137, springs 138^a, springs 139^a and the said relay 134 to battery B. The remaining operations of establishing and releasing a connection are the same as hereinbefore described for the cord circuit O.

It will accordingly be seen that I have provided a very efficient means for preventing two or more subscribers from operating their individual line switches and establishing connection with the same trunk line. Furthermore, it will be seen that I have provided new and improved means for cutting off the ringing current from the called line, whereby this ringing current is cut off the instant the called subscriber answers, whether this occurs during the ringing periods or during intervals of time between said ringing periods. Furthermore, it will also be seen that I have devised very efficient means for giving the operator a discriminating busy test, whereby she can discriminate between the busy test obtained from the multiple jack of a line connected to the answering end of a cord and that obtained from testing some other line.

While I have illustrated and described my invention in connection with a semi-automatic system employing line switches of a well-known type and a suitable form of operator's cord circuit, it will, of course, be understood that various changes and modifications can be made in this apparatus without in any way departing from the spirit of my invention, and, furthermore, that certain features of my invention are not limited to use in semi-automatic systems, but can be employed in connection with manual systems, while other features of my invention are equally as well adapted for use in connection with complete automatic systems.

What I claim as my invention is:—

1. In a telephone system, a plurality of subscribers' lines, a line switch individual to each subscriber's line, trunk lines adapted to be seized by said line switches, a master switch for controlling a group of said line switches, means for preventing subscribers who have removed their receivers from the switch-hook while said master switch is rotating from operating their line switches to connect with the same trunk after the master switch stops, and means for permitting said subscribers to connect one at a time with separate trunks.

2. In a telephone system, a plurality of subscribers' lines, a line switch for each subscriber's line, an operator's cord circuit, means controlled by said line switches for extending a connection from said subscriber's line to said cord circuit, and a discriminating busy test whereby the operator can distinguish between a busy test obtained

from a multiple jack of the calling line connected to the answering end of the cord and the busy test obtained from testing some other line.

3. In a telephone system, a plurality of subscribers' lines, an operator's three-strand cord circuit, an automatic progressively movable trunking switch for establishing connection with the answering end of said cord, and means for giving the operator a discriminating busy test whereby she can distinguish between the line connected with the answering end of the plug and some other line.

4. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, a relay individual to each line for controlling said equipment to extend connections from the lines, and means individual to said first line for rendering the equipment of the second line inoperative when the said first line makes a call to the third line, and means for energizing the relay of said second line while the relay of the first line is energized.

5. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, a relay individual to each line for controlling said equipment to extend connections from the lines, means including the relay individual to said first line for rendering the control circuit of the second line inoperative when the said first line makes a call to the third line and means for energizing the relay of said second line while the relay of the first line is energized.

6. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, trunk lines, a circuit individual to each line for controlling said equipment to extend connections from the lines to idle trunk lines, and a relay normally connected and individual to each of said lines, means associated with the relay of said first line for rendering the control circuit of the second line inoperative when the said first line makes a call to the third line, and means for energizing the relay of said second line while the relay of the first line is energized.

7. In a telephone system, a line, a trunking switch for said line, an operating magnet for said switch, a line relay for said line for controlling said magnet, a pair of contacts individual to said relay, a second line, a second trunking switch for said second line, an operating magnet for said second switch, a second line relay for controlling said second operating magnet, and an energizing circuit for said second operating magnet passing over said contacts.

8. In a telephone system, a line, a progressively movable trunking switch for said line, trunk lines, an operating magnet for said switch, a line relay for said line for

controlling said magnet to connect said line with any one of said trunk lines, a second line, a second progressively movable trunking switch for said second line, an operating magnet for said second switch, a second line relay for controlling said second operating magnet, and an energizing circuit for said second operating magnet under the control of said first relay.

9. In a telephone system, a calling line, a called line, a link circuit for connecting the two, a plug for extending a connection from the link to the called line, a source of signaling current, a signal for the called line, a circuit for applying said current to said called line to operate said signal, a relay for controlling said circuit to control the operation of said signal, a second relay in series with said source of current in said circuit, said first relay controlled by said second relay, which is operated in turn over said circuit while the said signal is being operated, and a relay for intermittently interrupting the said circuit.

10. In a telephone system, a calling line, a called line, a switch for connecting said lines, a signal for the called line, a circuit comprising a ringing current generator and a battery, another circuit comprising said battery and a resistance, a relay for alternately connecting said circuits in series with a slow acting relay, and a third relay for connecting said slow acting relay and circuits with the called line to periodically operate said signal, said third relay controlled by said slow acting relay.

11. In a telephone system, a first line, a second line, and a third line, talking conductors for each line, a switch for each line, a relay for each switch, an operating magnet for each switch, means for operating one of said relays over one of the talking conductors of its line, first to control its associated operating magnet to connect its line with another of said lines and second to render the operating magnets of the other of said switches inoperative.

12. In a telephone system, a first line, a second line, a third line, a switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby the first of said relays may operate its associated operating magnet to extend a connection to another line, and means whereby said first relay renders the controlling circuit for the operating magnets of said other switches inoperative.

13. In a telephone system, a first line, a second line, a third line, a switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultane-

ously whereby each of said relays may control the circuit of its associated magnet to extend a connection to another line, and may also control the circuit of the operating magnet of the next succeeding switch whereby said lines may be successively connected to other lines.

14. In a telephone system, a first line, a second line, a third line, an automatic switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby the first of said relays may operate its associated operating magnet to extend a connection to another line, and means whereby said first relay renders the controlling circuit for the operating magnets of said other switches inoperative.

15. In a telephone system, a first line, a second line, a third line, a progressively movable switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby the first of said relays may operate its associated operating magnet to extend a connection to another line, and means whereby said first relay renders the controlling circuit for the operating magnets of said other switches inoperative.

16. In a telephone system, a first line, a second line, a third line, an automatic switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby each of said relays may control the circuit of its associated magnet to extend a connection to another line, and may also control the circuit of the operating magnet of the next succeeding switch whereby said lines may be successively connected to other lines.

17. In a telephone system, a first line, a second line, a third line, a progressively movable switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby each of said relays may control the circuit of its associated magnet to extend a connection to another line, and may also control the circuit of the operating magnet of the next succeeding switch whereby said lines may be successively connected to other lines.

18. In a telephone system, a first line, a second line, a third line, a progressively movable automatic trunking switch for each line, a relay for each switch, an operating magnet for each switch, a circuit for each magnet controlled by its associated relay, means for energizing said relays simultaneously whereby each of said relays may control the circuit

of its associated magnet to extend a connection to another line, and may also control the circuit of the operating magnet of the next succeeding switch whereby said lines may be successively connected to other lines.

19. In a telephone system, a pair of telephone lines, trunk lines, a trunking switch for each telephone line for extending a talking connection from said line through said switch to an idle one of said trunk lines, a relay and an operating magnet for each switch, and means whereby one of said relays directly controls the circuit of both of said operating magnets.

20. In a telephone system, a pair of telephone lines, trunk lines, a trunking switch for each telephone line for extending a talking connection from said line through said switch to an idle one of said trunk lines, a relay and an operating magnet for each switch, means whereby one of said relays controls the circuit of both of said operating magnets, and means for energizing said relays simultaneously.

21. In a telephone system, a pair of telephone lines, trunk lines, a trunking switch for each telephone line for extending a talking connection from said line through said switch to an idle one of said trunk lines, a relay and an operating magnet for each switch, and means whereby one of said relays directly controls the circuit of both of said operating magnets, whereby said magnets may be successively energized.

22. In a telephone system, a line, a progressively movable trunking switch for said line, an operating magnet for said switch, a relay for said line for controlling said magnet, a second line, a second progressively movable trunking switch for said second line, an operating magnet for said second switch, a second line relay for controlling said second operating magnet, and an energizing circuit for said second operating magnet under the control of said first relay, and means for energizing the line relay of said second line while the line relay of the first line is in energized position.

23. In a telephone system, subscribers' lines, trunk lines, trunking switches for each line, a line relay for each switch, a magnet for each switch controlled by said line relay for operating the associated switch to connect a line with any one of said trunk lines, and a circuit for the magnet of each switch controlled by the line relay of another switch.

24. In a telephone system, a line, talking conductors for said line, a trunking switch for said line, an operating magnet for said switch, a line relay for said line energized over said talking conductors for controlling said magnet, a second line, a second trunking switch for said second line, an operating magnet for said second switch, a second line

relay for controlling said second operating magnet, and an energizing circuit for said second operating magnet under the control of said first relay.

25. In a telephone system, a pair of telephone lines, trunk lines, a trunking switch for each telephone line, a progressively movable element for each switch for extending a connection from its associated telephone line to any one of said trunk lines, a relay and an operating magnet for each switch for controlling said elements, and means whereby one of said relays controls the circuit of both of said operating magnets.

26. In a telephone system, a pair of telephone lines, trunk lines, a trunking switch for each telephone line, a progressively movable element for each switch for extending a connection from its associated telephone line to any one of said trunk lines, a relay and an operating magnet for each switch for controlling said elements, means whereby one of said relays controls the circuit of both of said operating magnets, and means for energizing said relays simultaneously.

27. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, a relay individual to each line for controlling said equipment to extend connections from the lines, and means individual to said first line for rendering the equipment of the second line inoperative when the said first line makes a call to the third line, and means for energizing the relay of said second line while the relay of the first line is energized, a signal for said third line, a source of signaling current, a circuit for applying said current to the line to operate said signal, a relay having a controlling circuit including said line for cutting off said signaling current from the line during the operation of said signal.

28. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, a circuit individual to each line for controlling said equipment to extend connections from the lines, and a relay individual to said first line for rendering the control circuit of the second line inoperative when the said first line makes a call to the third line, and means for energizing the relay of said second line while the relay of the first line is energized, a signal for said third line, a source of signaling current, a circuit for applying said current to the line to operate said signal, a relay having a controlling circuit including said line for cutting off said applying circuit to prevent the application of signaling current to the line.

29. In a telephone system, a first line, a second line, a third line, trunking equipment for said lines, a circuit individual to each line for controlling said equipment to extend connections from the lines, and means

individual to said first line for rendering the control circuit of the second line inoperative when the said first line makes a call to the third line, a signal for said third line,
5 a source of signaling current, means for intermittently applying signaling current to the line to operate said signal, and means for automatically disconnecting said signaling current from the line as soon as the

called subscriber responds while the signal 10 is being operated.

Signed by me at Chicago, Cook county, Illinois, this 20th day of November, 1913.

BERNARD D. WILLIS.

Witnesses:

H. W. KRACKE,
ALICE OSWALD.