T. G. MARTIN.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED FEB. 26, 1914.

1,289,853.

Patented Dec. 31, 1918.

3 SHEETS—SHEET 1.

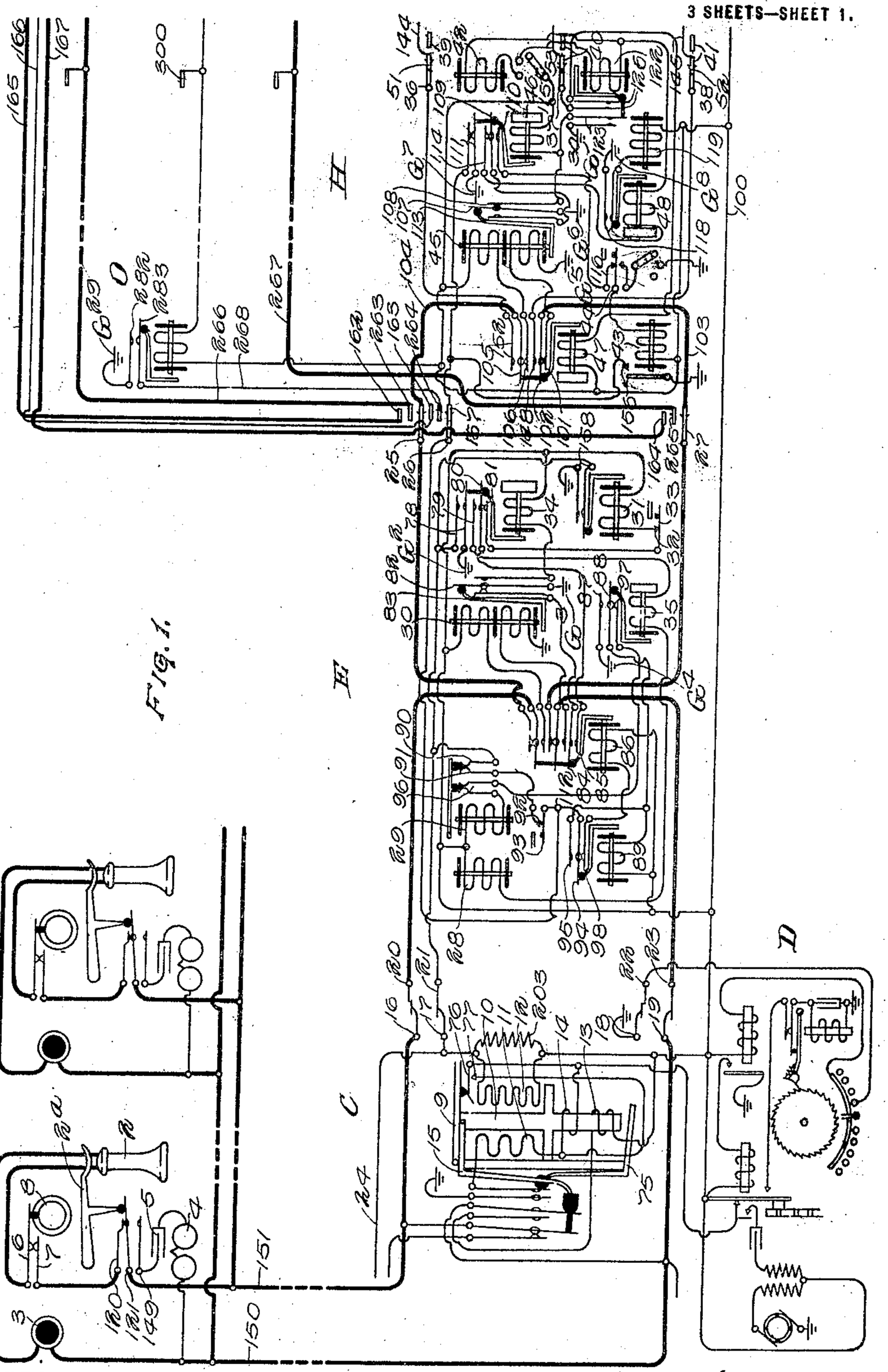

FIG. 1.

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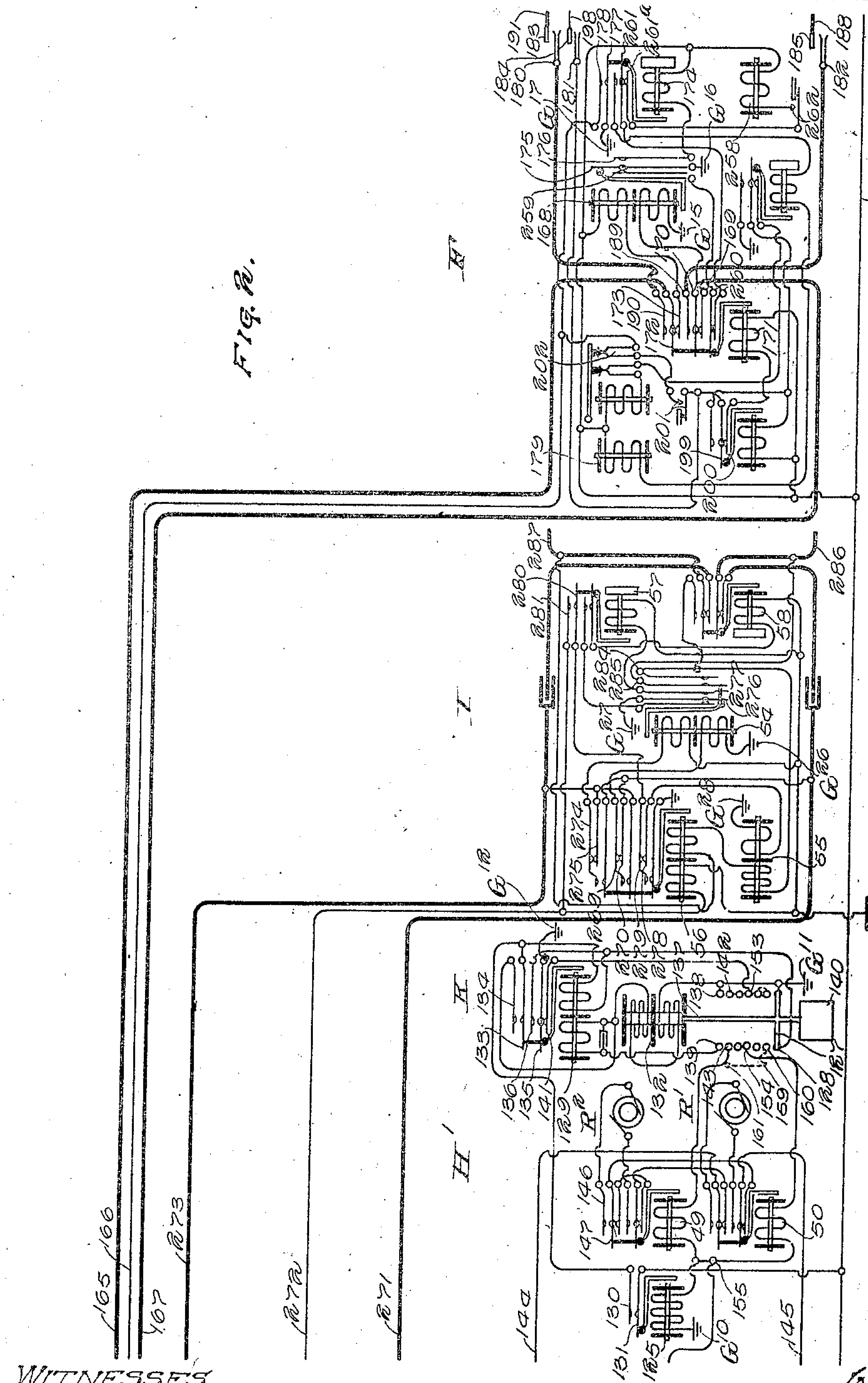

WITNESSES

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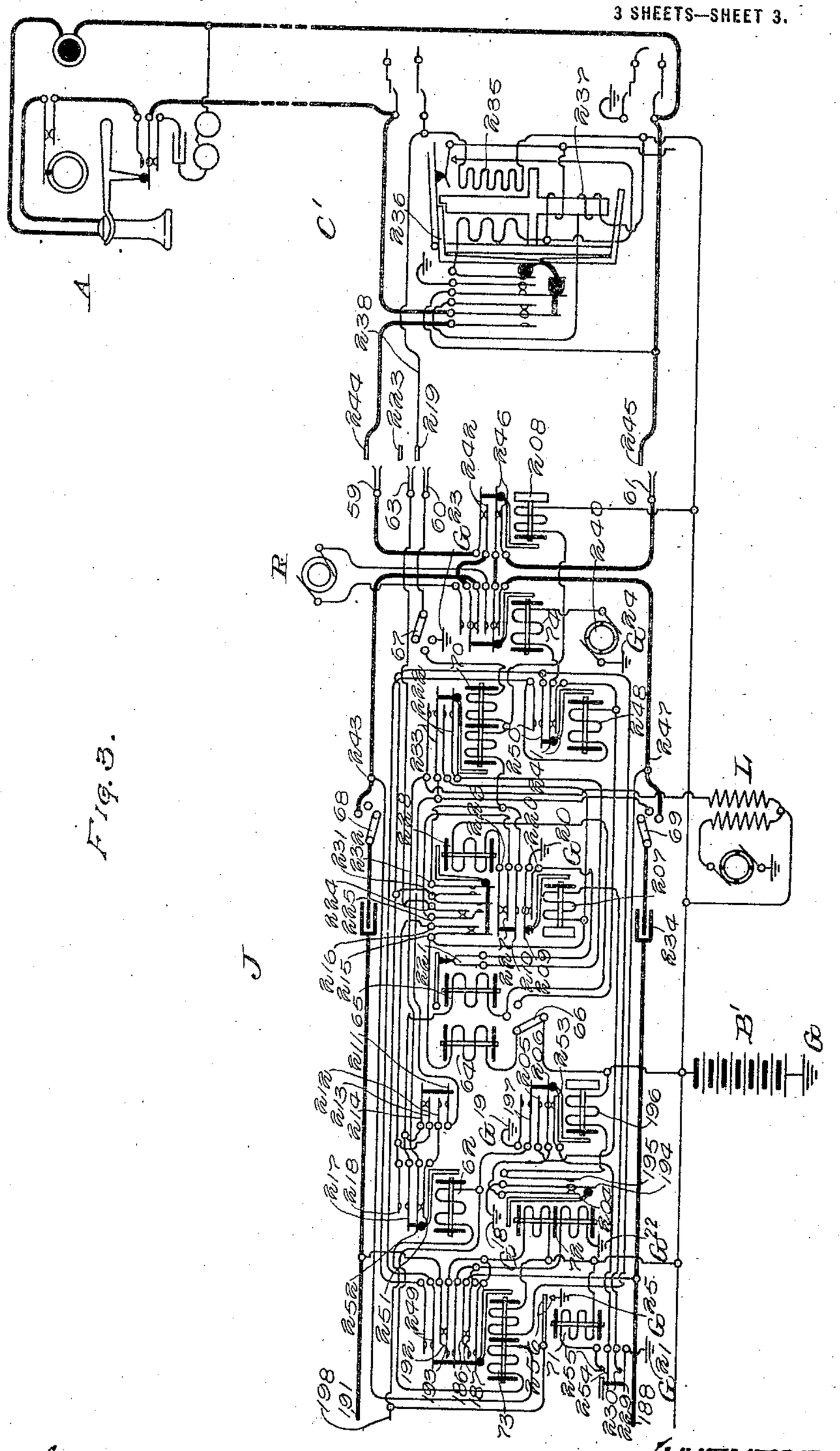

Fig. 3.

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UNITED STATES PATENT OFFICE.

TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,289,853. Specification of Letters Patent. Patented Dec. 31, 1918.

Application filed February 26, 1914. Serial No. 821,246.

To all whom it may concern:

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

My invention relates to improvements in automatic telephone systems and has for its object several features of improvement whereby increased efficiency of operation is obtained.

Among the features of my invention is the provision of improved means for enabling one subscriber on a party-line to signal a second subscriber on the same line. A further feature of my invention relates to improved means for making a trunk busy—that is, to prevent this trunk being seized while the same is in use. Heretofore, it has been customary when such trunk is seized to place a guarding potential on the third conductor of the trunk which made the private contacts of this trunk busy at its two ends. Where this trunk extends between exchanges, however, it is found that this potential at the distant end was oftentimes ineffective to prevent seizure of the trunk at that end. The object of my invention, therefore, is to provide means for locally applying this guarding potential to the opposite ends of the trunk, whereby a more efficient and effective guarding potential is obtained irrespective of the length of the trunk.

A further feature of my invention relates to improved means for providing a discriminating service—that is, providing means whereby certain subscribers can make certain connections, while other subscribers cannot make these connections.

More specifically, my invention relates to the provision of a connector switch through which certain subscribers can extend a call through certain levels of this connector, while when other subscribers seize such connector they are unable to extend a call through these particular levels, and thus are prevented from obtaining connection with the particular subscribers connected with the trunks located on these levels.

These and other objects of my invention will be more readily understood by reference to the accompanying drawings, in which I have illustrated my invention in connection with automatic switches of well-known types.

Figures 1 and 2 taken together show means whereby one party on a party line may establish connection with and ring another party on the same line. Means are also provided whereby a calling subscriber A′ in a certain exchange may establish connection with a main exchange through the medium of a repeater in a third exchange.

Figs. 1, 2 and 3 taken together show means whereby a subscriber A′ may establish connection with a subscriber A through the medium of a discriminating rotary connector J.

Referring to Figs. 1 and 2, I have shown diagrammatically a polystation subscriber's line, together with its individual switch C at the central office, a master switch D, a selector E and a selective device H for selecting different groups of frequency ringing relays H′. The trunk lines leading to the selective device H terminate in a level of the first selector banks. Other levels of the said selector banks contain trunk lines leading to a main office through the medium of repeaters located in a third office, while certain other levels of said selector banks contain trunks leading to selector switches F.

Referring to Figs. 1, 2 and 3, I have shown diagrammatically a subscriber's line, together with its individual switch C, at the central office, a master switch D, a selector E, a selector F, a discriminating rotary connector J, the called subscriber's line switch C′ and the called substation A. At B and B′ there are shown batteries for furnishing current for operating the central office apparatus and for talking purposes. The subscribers' substations A′, A² and A are of any suitable or approved type. Referring to the substation A, each of the substations shown herein comprises the usual receiver 2, transmitter 3, switch-hook 2ª, ringer 4 and condenser 5. Being an automatic substation it is also provided with an impulse transmitter or calling device, which is represented herein by a pair of impulse springs 6 and 7 and an impulse wheel 8, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 6 and 7 may be momentarily separated a number of times corresponding to each digit of the number to be called.

The subscriber's individual switch C is of the general type of subscriber's switch shown in British patent to R. W. James No. 26,301 of 1906, being, however, of the particular type disclosed in British patent to T. G. Martin No. 1419 of 1910. This line switch comprises among other details a plunger (not shown) attached to the end of a so-called plunger arm 9 which is controlled by the magnet 10. The magnet 10 comprises four windings, namely, a pull-down winding 11, a cut-off or holding winding 12, a line winding 13 and an auxiliary winding 14. The core of the magnet 10 is so constructed that the magnetic circuit of the windings 11 and 12 is separate from that of the windings 13 and 14. The winding 11 operates both the plunger arm 9 and the armature 15, while the winding 12 is only strong enough to operate the cut-off armature 15 and to hold the plunger arm 9 in its operated position. When the plunger arm 9 is operated, the plunger is forced into a bank of contact springs, forcing the springs 16, 17, 18 and 19 into engagement with the springs 20, 21, 22 and 23, respectively. Although only one set of springs (16–23) is shown, each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line leading to a first selector switch E. Each trunk line is connected in multiple with the corresponding springs of all the line 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 13, as will hereinafter be more fully explained.

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 said British Patent No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position to engage the terminal of an idle trunk line.

The first selector switch E is of the general type of selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, except that the so-called side switch is omitted and the circuits are modified to adapt the switch to operate in a system in which it is controlled by impulses delivered over two sides of the line in series. Among other details, the selector E comprises a bank of contacts arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of wipers 25, 26 and 27 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 28 and a rotary movement controlled by the rotary magnet 29. The operations of the various parts of the switch are controlled through the medium of the double-wound line relay 30. Means for permitting the switch to be restored to normal position are provided in the release magnet 31, which, upon energizing, withdraws the retaining pawls from the shaft. The springs 32 and 33 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 34 and 35 are slow acting—that is, relays which deënergize slowly after their energizing circuits are broken.

The ring-back selective device H comprises among other details the wipers 36, 37 and 38, which are carried upon a rotary shaft (not shown) and are adapted to be advanced step by step over the bank contacts 39, 40 and 41 through the medium of a stepping magnet 42. The magnet 43 is a release magnet, which, when energized, withdraws a holding pawl from the shaft of the switch and allows the wipers to be restored to normal position by a spring in a well-known manner. The off-normal contact 44, which is included in the circuit of the release magnet, is controlled by the shaft of the switch so as to be closed only when said shaft is rotated one or more steps from its normal position. The operation of the switch is controlled by the calling subscriber through the medium of a double-wound line relay 45. The relays 46, 47 and 48 are relays which deenergize slowly after their energizing circuits have been broken.

The ringing device H′ comprises among other details a solenoid interrupting device K, together with a group of relays and two ringing current generators. The solenoid interrupting device K, when in operation, controls circuits through the ringer relays 49 and 50. Each of said relays, when energized, applies ringing current from their respective generators R′ and R^2 to the line bank contacts 51 and 52 of the ring-back selective device H. The apparatus as shown herein is adapted to be used in connection with a four-party line system. The four generators R′, R^2, R^3 and R^4 (the generators R^3 and R^4 not being shown) produce ringing current of four different characters. The ringers 4 of the different substations may be arranged in any well-known manner to respond only to the ringing current from their corresponding generator. For instance, the generator R′ may produce ringing current of the proper character to operate the ringer at the substation A′; the generator R^2 may produce current to operate the ringer at the substation A^2; the generator R^3 may produce current to operate the ringer at the substation A^3 (not shown) and the generator R^4 may produce current to operate the ringer at the fourth substation A^4 (not shown). Each set of bank contacts 39, 40 and 41 (only two sets of which are shown) lead to a ringing de-

vice H′. The first set of contacts, namely 51, 52 and 53, is connected to the ringing device H′, which device alternately applies ringing current to the line from the generators R′ and R². The second set of contacts is connected to a ringing device H′ (not shown), which device alternately applies ringing current to the line from the generators R′ and R³. The third set of contacts is connected to a ringing device H′ (not shown), which device alternately applies ringing current to the line from the generators R′ and R⁴. The fourth set of contacts is connected to a ringing device H′ (not shown), which device alternately applies ringing current to the line from the generators R² and R³. The fifth set of contacts is connected to a ringing device H′ (not shown), which device alternately applies ringing current to the line from the generators R² and R⁴. The sixth set of contacts is connected to a ringing device H′ (not shown), which device alternately applies ringing current to the line from the generators R³ and R⁴. From the foregoing it will be apparent that I have connected the different generators to the different devices H′ in such a manner as to allow any calling subscriber to signal any other subscriber on his own line. For example, if the subscriber at substation A⁴ wishes to call the subscriber at substation A′ he will cause his line to be connected to a selective device H and then operate it to rotate onto the third set of contacts 39, 40 and 41, which contacts are connected with a device H′ which supplies current from the generators R′ and R⁴. The ringing current from the generator R′ will operate the called substation bells, while the ringing current from the generator R⁴ will operate the calling substation bells.

The repeater I is used as a means of repeating impulses from a substation at one exchange to operate switches in another exchange. Among other details it comprises the double-wound relays 54, 55 and 56 and the slow acting relays 57 and 58. The slow acting relay 58 operates to cut the condensers out of the circuit while the impulses are being transmitted.

The selector F is similar to the selector E shown in Fig. 1.

The connector J is of the same general type of connector switch as that disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The circuits are also modified to adapt the switch to operate in a system embodying the principles of my invention. Like the selectors, the connector is provided with a shaft (not shown) carrying the wipers 59, 60 and 61. Being a so-called rotary connector on the top level and also of a discriminating character it is provided with the marginal relay 62 and an extra shaft wiper 63. The shaft is controlled by the vertical magnet 64 and the rotary magnet 65. The usual side switch comprising the wipers 66, 67, 68 and 69 is controlled by the private magnet 70 in the usual and well-known manner. The magnet 71 is the usual release magnet. The line relay 72 is connected to the line through the reversing springs of the so-called back-bridge relay 73. The ringing relay 74 is the means by which ringing current is applied to the called line or trunk. The busy signaling machine L, as represented herein, comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and an interrupter of high frequency. Through the medium of this interrupter an interrupted current is supplied to the primary winding, which induces an alternating current in the secondary winding, whereby, when said winding is connected with the subscriber's line, a buzzing sound is heard in the receiver.

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

Associated with the trunk line leading from the first selector banks to the repeaters I (which are located in another exchange) is a group of holding relays O (only one of said relays being shown) which are for the purpose of supplying a holding ground to the first selector and also for the purpose of putting a guarding ground potential on the private bank contact of the trunk lines in the banks of all the first selectors that have access to the trunk lines from the first exchange. The repeaters I place a guarding ground potential on the private bank contacts of the trunk lines in the banks of the selectors which have access to said trunk lines from the exchange in which the said repeaters are located.

A general description of the apparatus having been given, it will now be explained how one of the subscribers on the party-line may signal another subscriber on the same line. For example, should the subscriber at substation A′ call the subscriber at the substation A², both of whom are on the same line. It is assumed herein that the second level of the first selectors is reserved for reverting call purposes. For this purpose there is connected to the contacts of this level a plurality of trunk lines, each of which connect to a ring-back selective device H.

Upon the removal of the receiver from the switch-hook at the substation A′ preparatory to making a call, an energizing circuit is closed through the line winding 13

of the individual switch C, thereby attracting the line armature 75. The armature, upon being attracted, closes a circuit through the pull-down coil 11 in series with the auxiliary winding 14. The pull-down coil, upon energizing, attracts the plunger arm 9 to force the plunger into the bank of springs 16 to 23, inclusive. It also operates the cut-off armature 15, thereby disconnecting the line winding 13 from the line. The armature 75 does not fall back immediately, however, owing to the fact that the winding 14 is still in series with the pull-down winding 11. Upon the plunger arm 9 being attracted the springs 76 and 77 are brought together to short-circuit the auxiliary winding 14, making same slightly slow acting. The armature 75 being slow to fall back allows sufficient time for a holding circuit to be closed in the switch ahead for the cut-off or holding winding 12. The engagement of the springs 16 and 19 with the springs 20 and 23, respectively, extends the subscribers' lines to the line relay 30 of the selector E. The line relay 30 of the selector switch E is thereupon energized, closing a circuit through the relay 34. The relay 34, upon energizing, closes the above-mentioned holding circuit through the cut-off winding 12 of the line switch C. This circuit extends from ground G^2 through the springs 78, bank springs 21 and 17 and the cut-off winding 12 to the battery lead 100, thence through battery B to ground G. The winding 12, upon energizing, holds the armature 15 and the plunger arm 9 in their operated positions after the circuit of the pull-down winding is broken by the falling back of the line armature 75. A guarding ground potential is supplied to the connector private bank contact of the calling line as soon as the relay 34 is energized. This circuit extends over the circuit just traced to the bank spring 17, thence over the conductor 24 to said private bank contact. The energization of the relay 34 also prepares a circuit for the vertical magnet by bringing into engagement the springs 79 and 80 and opens the circuit of the release magnet 31 at the springs 81 and 80.

The calling subscriber now operates his calling device for the digit 2, whereby the substation impulse springs 6 and 7 are separated twice momentarily, each time breaking the circuit of the selector line relay 30. The relay 34 of the selector being slow acting does not deënergize during the momentary interruptions of its circuit by the line relay 30 and consequently, each time the latter relay deënergizes, an impulse is transmitted over the circuit extending from ground G^3 through the contact of springs 82 and 83, springs 84 and 85 of the relay 86, springs 80 and 79 of the relay 34, relay 35 and the vertical magnet 28 to the battery lead 100. The vertical magnet receives two impulses over this circuit and operates to raise the switch shaft and wipers two steps to a position opposite the second row or level of bank contacts. The off-normal springs 32 and 33 close as soon as the shaft is raised one step, but the circuit of the release magnet 31 still remains open at the springs 80 and 81. The slow acting relay 35 is maintained in its energized position while impulses are being sent through it to the vertical magnet, and in its energized position closes a circuit extending from ground G^4 through the springs 87 and 88 and the relay 89 to the battery lead 100. The relay 89, upon energizing, closes a locking circuit for itself extending from ground G^2 at the relay 34 through the springs 78, rotary magnet springs 90 and 91, off-normal springs 92 and 93 and the springs 94 and 95 of the relay 89, thence through the relay 89 to the battery lead 100. Thus, upon the deënergization of the relay 35 after the last impulse is delivered to the vertical magnet, the relay 89 remains energized and the circuit of the rotary magnet is closed. This circuit extends from ground G^2 through the springs 78, 90 and 91, 92 and 93, 94 and 95, 88 and 97, interrupter springs 96 and the rotary magnet 29 to the battery lead 100. The rotary magnet, upon energizing, rotates the wipers one step, and, by opening the springs 90 and 91, disconnects ground G^2 from itself and the relay 89. If the first trunk line of the second level is idle, the relay 89 deënergizes as soon as the springs 90 and 91 are opened. If this trunk line is busy, however, the private wiper 26 finds the contact with which it engages provided with a guarding ground potential which is transmitted to the relay 89 through the springs 94 and 95, thereby preventing it from deënergizing. The rotary magnet, however, deënergizes when the springs 96 disengage, regardless of whether the relay 89 remains energized or not. If the relay 89 remains energized, the circuit of the rotary magnet will be again closed as soon as the armature drops back far enough to close the springs 96. The rotary magnet will, therefore, operate in the manner of a buzzer to advance the wipers step by step over the contacts until the non-grounded contact of an idle trunk line is reached by the wiper 26, whereupon the relay 89 deënergizes. The relay 89, upon deënergizing, whether after one or several operations of the rotary magnet, permanently breaks the circuit of the magnet 29 and closes the circuit of the switching relay 86. The circuit through said relay 86 extends from ground G^2 through the springs 78, 90 and 91, 92 and 93, 94 and 98 and the relay 86 to the battery lead 100. The relay 86, upon energizing disconnects the line relay 30 from the line and extends the line connec-

tion over the heavy conductors through the wipers 25 and 27 to the ring-back selective device H. As soon as the connection is completed with the selective device H, the line relay 45 becomes energized. This circuit extends from ground G^5 through the lower winding of the relay 45, springs 101 and 102 of the switching relay 47, conductor 103, wiper 27, thence over the heavy conductors to and through the substation A′, back over the heavy conductors, wiper 25, conductor 104, springs 105 and 106 and the upper winding of the relay 45 to the battery lead 100. The relay 45, upon energizing, closes a circuit through the slow relay 46. This circuit extends from ground G^6 through the springs 107 and 108 and the relay 46 to the battery lead 100. The relay 46, upon energizing, opens the circuit of the release magnet 43 at the springs 109 and 110 and closes a holding ground for the relay 86 of the selector E and the winding 12 of the line switch C. Said holding circuit extends from ground G^7 through the springs 111, wiper 26 and the springs 94 and 98 of the relay 89, thence through the relay 86 to the battery lead 100. The holding ground for the winding 12 extends from ground G^7 over the circuit just traced to the point 112, thence through the normal springs 93 and 92, interrupter springs 91 and 90, springs 21 and 17 and the winding 12 to the battery lead 100. The apparatus is now in readiness for the operation of the dial for the second digit. The ring-back selective device H must now operate to select one of the ringing devices H′. It will be seen from the foregoing description that the contacts 51, 52 and 53 (the first set of contacts of the second bank level) connect with the ringing device H′, which device is connected with the generators R′ and R^2; and as the subscriber A′ wishes to call the subscriber A^2, he will next call the digit 1, which will connect his line with the first ringing device H′.

The operation of the calling device for the second digit 1 opens the circuit of the relay 45 once. The slow acting relay 46 does not deënergize during the momentary interruptions of its circuit by the relay 45, thereby preventing the first selector E and the line switch C from releasing. One impulse of current is transmitted over the circuit extending from ground G^6 through the contact of springs 107 and 113, springs 109 and 114, relay 48, rotary magnet 42 and the side switch wiper 115 (in first position) to the battery lead 100. The rotary magnet receiving one impulse of current over said circuit operates to rotate the switch shaft and wipers one step onto the contacts 51, 52 and 53. The off-normal springs 44 and 116 close as soon as the shaft is rotated one step, but the circuit of the release magnet 43 still remains open at the springs 110 and 109. The slow acting relay 48 is maintained in its energized position while impulses are being transmitted through it to the rotary magnet, and in its energized position closes a circuit extending from ground G^8 through the contact of springs 118 and the relay 119 to the battery lead 100. As soon as the relay 48 deënergizes, the circuit of the relay 119 is broken at the contact of springs 118. The relay 119 deënergizing allows the side switch to step to second position in a well-known manner.

The subscriber A′ now replaces his receiver upon the switch-hook. The line relay 45 then deënergizes, its circuit being open at the contact of springs 120 and 121 of the substation A′. The relay 46 being slow acting does not immediately deënergize, thus maintaining the relay 86 of the selector E and the winding 12 of the line switch C energized until a new holding circuit is completed. The relay 45, upon deënergizing, closes a circuit extending from ground G^6 through the contact of springs 107 and 113, springs 109 and 114, relays 48 and 122 in series and the side switch wiper 115 (in second position) to the battery lead 100. The relay 48, upon energizing, again closes a circuit through the relay 119 to the battery lead 100, the relay 119 holding the side switch in second position. The relay 122, upon energizing, closes a circuit extending from ground G^{30} through the contact of springs 123 and the slow acting relay 46 to the battery lead 100. The relay 46 thus remains energized, maintaining the relay 86 of the selector E and the winding 12 of the line switch C energized. At the same time a circuit is closed extending from ground G^{10} (Fig. 2) through the relay 125, bank contact 53, wiper 37, contact of springs 126 and the relay 47 to the battery lead 100. The relay 125 is of a high resistance and therefore the relay 47 does not receive sufficient current to operatively energize. The relay 47 does, however, receive sufficient current when in series with the relay 49 or the relay 50 to operatively energize. The relay 125, upon energizing, closes a circuit extending from ground G^{11} at the solenoid K through the wiper 127, contact 128, right-hand winding of the relay 129 and the springs 130 and 131 to the battery lead 100. The relay 129 becoming operatively energized completes a circuit extending from ground G^{11} through the lower and upper windings of the solenoid 132, contact of springs 134 and 133 and contact of the springs 130 and 131 to the battery lead 100. A locking circuit for the relay 129 extends from ground G^{12} through the springs 135 and 136, right-hand winding of the relay 129 and contact of springs 130 and 131 to the battery lead 100. The solenoid 132, upon energizing, raises its shaft 137 and wiper

127 to a point where the wiper completes a circuit extending from ground G^{11} through the contact 138, wiper 127, contact 139, left-hand winding of the relay 129, springs 134 and 133 and the springs 130 and 131 to the battery lead 100. The relay 129 being a differentially-wound relay, the energization of the left-hand winding neutralizes the effect of the right-hand winding, and the relay 129 deënergizes. The deënergization of the relay 129 breaks its own locking circuit and also the circuit of the solenoid 132, whereupon the shaft starts to move slowly downward at a uniform rate of speed, due to a delaying device 140, which may be of any well-known type. The wiper 127 closes a circuit extending from ground G^{12} through the springs 135 and 141, contact 142, wiper 127, contact 143, relay 49, bank contact 53 (Fig. 1), wiper 37, springs 126 and the relay 47 to the battery lead 100. The relays 49 and 47 operatively energize in series, the relay 47 to disconnect the line relay 45 from the conductors 103 and 104 and to connect said conductors to the wipers 51 and 52, respectively. The relay 49, upon energizing, applies ringing current from the generator R^2 to the conductors 144 and 145. The path of the ringing current extends from one terminal of the generator R^2 through the springs 146 and 147 to the conductors 145, bank contact 52, wiper 38, contact springs 148 and 102, conductor 103 and the heavy trunk conductors to one side of the substation line 150, thence through the different bells 4 and condensers 5, switch-hook springs 149 and 121, over the other side of the substation line 151, over the heavy trunk conductors, conductor 104, springs 152 and 105, wiper 36, contact 51 and the conductor 144 back to the other side of the generator R^2. The bells at the substation A^2 are the only ones that respond to ringing current from the generator R^2. Therefore, the subscriber A^2 is signaled that a connection is desired. The shaft 127 having carried the wiper past the contacts 142 and 143, the relays 47 and 49 deënergize, thus returning to normal position. The wiper 127 next engages the contacts 153 and 154, closing a circuit extending from ground G^{12} through the springs 135 and 141, contact 153, wiper 127, contact 154 and the relay 50 to the point 155, thence over the before-traced circuit through the relay 47 to the battery lead 100. Both relays 47 and 50 are operatively energized, the relay 47 with the same result as before stated and the relay 50 to apply ringing current from the generator R' to the conductors 144 and 145 to the substation line over the before traced circuit. The bells at the substation A' respond to said signaling current, thus signaling the subscriber at the substation A' that the called substation A^2 is being signaled. The shaft 127 having carried the wiper past the contacts 153 and 154, the relays 47 and 50 deënergize, thus returning to normal position. It will be seen that the relay 47 is slow acting and does not deënergize until after the relay 50 has deënergized, thus short-circuiting the line conductors 144 and 145. The object in short-circuiting the line conductors after the ringing current is disconnected therefrom, and before the connection with the line relay 45 is restored, is to provide a path for the discharge of the condensers on the calling line, so that they will not cause a momentary energization of the relay 45. The shaft 127 having returned to normal position again closes the circuit through the relay 129 which controls the solenoid 132. Thus it will be seen that the relays 49 and 50 will continue to be alternately energized and deenergized to alternately ring the bells at the calling and called substations A' and A^2 until the called subscriber responds by removing his receiver from the receiver hook. As soon as this occurs, or as soon thereafter as the ringing relay deënergizes, if it happens to be energized at the time, the line relay 45 again becomes energized and by opening the contact between the springs 113 and 107 allows the relays 48 and 122 to deënergize. The deënergization of the relay 122 opens the contact 126, which allows the relay 125 to be deënergized, which in turn opens the circuit of the solenoid control relay 129. The opening of the contacts 123 of the relay 122 opens the circuit of the relay 46, but its previous circuit was restored through the contact of springs 107 and 108, when the line relay 45 again energizes. The deënergization of the relay 48 allows the private magnet 119 to deënergize and the side switch to step to third position. The calling subscriber's bell ceasing to ring is an indication to him that the called subscriber has answered. He then removes his receiver and the two subscribers carry on an uninterrupted conversation, the talking current being supplied through the windings of the line relay 45 over the heavy conductors shown.

The release of the central office apparatus is brought about by the hanging up of the receivers at both the calling and the called substations. When both receivers are replaced, the line relay 45 deënergizes and breaks the circuit of the slow acting relay 46, which relay, upon deënergizing, closes a circuit extending from ground G^6 through the springs 107 and 113, springs 109 and 110, off-normal springs 116 and 44, release magnet 43 to the battery lead 109. The release magnet 43, upon energizing, permits the shaft of the selective device H to be restored to normal position, thus restoring the side switch to first position, where-

upon the contact 44 is opened and the magnet 43 permitted to deënergize. During the energization of the release magnet 43, contact between the springs 156 was closed, thus supplying a guarding ground potential to the bank contact 157 during the release of the selective device H. The deënergization of the relay 86 of the selector E completes a circuit extending from ground G^3 through the springs 82 and 83, springs 84 and 85, springs 80 and 81, off-normal springs 32 and 33 and the release magnet 31 to the battery lead 100. The magnet 31, upon energizing, permits the shaft of the selector to be restored to normal position, whereupon the contact between the springs 32 and 33 is opened and the release magnet permitted to deënergize. The energization of the release magnet 31 closes the contact between the springs 158, thus completing a guarding potential to the bank contact 21 during the release of the switch H. The relay 46, upon deënergizing, also opens the circuit of the holding winding 12 of the line switch C and the line switch is permitted to release.

Referring to Fig. 2, the conductor 159 is shown dotted. It will be readily seen that if the contact point 160 is joined to the contact point 161 by means of the conductor 159, the relay 49 will be energized twice and the relay 50 once during the return motion of the shaft 137 to normal position. Therefore, the called subscriber will be signaled twice, while the calling subscriber will be signaled only once. It is now apparent that a different method of grouping of the generators will be necessary. The generators will be connected to the different ringing devices H′ in such a manner as to afford any calling subscriber access to a ringing device H′, which device will signal the called subscriber's bells twice while it is signaling the calling subscriber's bells only once. I will therefore connect the generators to the twelve different ringing devices in the following manner: The first ringing device H′ is connected to the generators R′ and R^2, the second device H′ to the generators R′ and R^3, the third device H′ to the generators R′ and R^4, the fourth device H′ to the generators R^2 and R′, the fifth device H′ to the generators R^2 and R^3, the sixth device H′ to the generators R^2 and R^4, the seventh device H′ to the generators R^3 and R′, the eighth device H′ to the generators R^3 and R^2, the ninth device H′ to the generators R^3 and R^4, the tenth device H′ to the generators R^4 and R′, the eleventh device H′ to the generators R^4 and R^2 and the twelfth device H′ to the generators R^4 and R^3. As there are now twelve different ringing devices H′, we must connect two levels of the first selector banks to the selective devices H, one level of said selective devices H having access to a part of the ringing relay devices H′ and the other level having access to the remaining ringing relay devices H′.

It having been explained how a reverting call may be made, I will now explain how the subscriber A′ may call the subscriber A, whose number is 4201. The substation A is one of a number of similar substations whose normals terminate in bank contacts in the tenth level of the connector switch J. The said tenth level of said connector may be used where a business house or private branch exchange, for instance, desires to have a plurality of trunk lines extending to the main office, but wishes to be given only one number.

Since the operation of the line switch C and the selector E have hereinbefore been described, we will assume that the subscriber A′ has removed his receiver and rotated his dial for the first digit 4, connecting the wipers 25, 26 and 27 of the first selector E with the bank contacts 162, 163 and 164. As soon as the connection is completed with the conductors 165, 166 and 167, the line relay 168 of the selector F is energized. This circuit extends from ground G^{15} through the lower winding of the relay 168, springs 169 and 170 of the relay 171, conductor 167, bank contact 164, wiper 27, over the heavy conductor to the substation A′, through the substation A′, over the return conductor, wiper 25, bank contact 162, conductor 165, springs 172 and 173 and the upper winding of the relay 168 to the battery lead 100. The relay 168, upon energizing, closes a circuit through the slow acting relay 174, said circuit extending from ground G^{16} through the contact of springs 175 and 176 and the relay 174 to the battery lead 100. The relay 174, upon energizing, closes a circuit extending from ground G^{17} through the springs 177 and 178, conductor 166, bank contact 163 and the wiper 26 to the point 112, at which point the circuit divides, one path extending through the contact of springs 94 and 98 and the relay 86 to the battery lead 100, maintaining the relay 86 of the selector E energized. The other branch extends from the point 112 through the springs 93 and 92, springs 91 and 90, bank contact 21, wiper 17 and the winding 12 to the battery lead 100, holding the winding 12 of the line switch C energized. The relay 174 also provides a guarding ground potential extending from ground G^{17} through the springs 177 and 178, conductor 166, bank contact 163 and thence to the corresponding contact in the bank of each selector switch which has access to the selector F.

The apparatus is now in position to receive impulses for the second digit 2. The action of the selector F being similar to that of the selector E, a description of the same will not be given in detail. The subscriber at the substation A′ now operates his dial

in accordance with the second digit 2 of the called number. The dial operates to separate the impulse springs 6 and 7 twice, thus breaking the circuit of the line relay 168 of the selector F. The line relay 168, in response thereto, repeats two impulses to the vertical magnet 179, which raises the wipers to a point opposite the second level of bank contacts of the selector F. At this point the wipers search for an idle trunk line leading to the connector J. The wipers 180, 181 and 182 make contact with the bank contacts 183, 184 and 185, respectively, and close a circuit through the line relay 72 of the connector switch J. The said circuit extends from ground G^{22} through the lower winding of the relay 72, springs 187 and 186, conductor 188, bank contact 185, wiper 182, springs 189 and 170, conductor 167, over the heavy conductor to and through the substation A', over the return conductor, conductor 165, springs 190 and 172, wiper 180, bank contact 183, conductor 191, springs 192 and 193 and the upper winding of the relay 72 to the battery B. The relay 72, upon energizing, completes a circuit extending from ground G^{18} through the springs 194 and 195, slow acting relay 196 to battery B. The relay 196 is energized over this circuit and operates to complete a circuit extending from ground G^{19} through the springs 197, marginal relay 62, conductor 198, bank contact 184, wiper 181, springs 199 and 200 and the relay 171 to the battery lead 100, thus maintaining the relay 171 in an energized position. A new holding circuit for the relay 86 of the selector E and the winding 12 of the line switch C extends over the above circuit traced to the wiper 181 and from thence through the springs 201, springs 202 and the trunk conductor 166 over a before-mentioned circuit, thus holding the relay 86 and the winding 12 energized. The relay 196 also provides a guarding ground potential extending from ground G^{16} over the above-traced circuit to the bank contact 184 and thence to the corresponding contact in the bank of each selector which has access to the connector J. The holding winding 12 of the line switch C and the back-bridge relays 86 and 171 of the selectors E and F are connected in parallel. Said relays and winding being of rather high resistance do not permit enough current to flow through the marginal relay 62 of the connector J for said relay to operatively energize, but by placing the resistance 203 in bridge of the winding 12 of the line switch C enough current is permitted to flow to operatively energize the marginal relay 62 of the connector J.

When the substation calling device is operated for the third digit 0, the circuit of the line relay 72 is broken ten times. Since the relay 196 is slow acting it does not deenergize during the momentary interruptions of its circuit by the relay 72, so that each time the latter relay is deënergized a circuit is closed extending from ground G^{18} through the springs 194 and 204, springs 206 and 205, relay 207, vertical magnet 64 and the side switch wiper 66 (in first position) to battery B. The vertical magnet receives ten impulses over this circuit and operates to raise the switch shaft and wipers 59, 60, 61 and 63 to a position opposite the tenth level of bank contacts. The relay 207, which was included in series with the vertical magnet, remains in its energized position during the entire time that impulses are being sent through it, and operates to close the circuit of the relay 208 and the private magnet 70 in series. Said circuit extends from ground G^{20} through the springs 209 and 210, left-hand winding of the private magnet 70 and the slow acting relay 208 of battery B. The connector J being a rotary connector on the tenth level, the shaft operates to close contact between the springs 211 and 212 and to open contact between the springs 213 and 214 as soon as the shaft has reached its tenth-level position. After the last impulse is delivered, the relay 207 opens the circuit of the private magnet 70, which, upon deënergizing, permits the side switch to advance from first to second position. The movement of the side switch wiper 66 from first to second position transfers the battery connection from the vertical magnet 64 to the rotary magnet 65. The calling subscriber now operates his calling device for the last digit 1, in response to which the connector line relay operates to transmit one impulse through the rotary magnet 65 and the relay 207 in series. Said circuit extends from ground G^{18} through the springs 194 and 204, springs 206 and 205, relay 207, springs 215 and 216, springs 218 and 217, rotary magnet 65 and the side switch wiper 66 (in second position) to battery B. The rotary magnet responds by rotating the shaft and wipers one step onto the first bank contact. As stated before, this is the first of the lines leading to the called subscriber. If this contact is not busy, the magnet 70 will deënergize and permit the side switch to pass to third position in the usual manner, completing the line connection to the called subscriber. This connection will be fully explained hereinafter. Assuming that the wiper 60 engages a contact which is supplied with a guarding ground potential, the private magnet will remain energized and retain the side switch in second position. The said circuit extends from ground at the private bank contact 219 through the wiper 60, side switch wiper 67 (in second position), right-hand winding of the private magnet 70 and the relay 208 to battery B. As soon as the slow acting relay 207 deënergizes, a circuit is

completed which extends from ground G^{20} through the springs 209 and 220, interrupter springs 221, springs 222, spring 215 and 216, springs 218 and 217, rotary magnet 65 and the side switch wiper 66 (in second position) to battery B. The rotary magnet, upon energizing, operates to step the shaft wipers one step onto the next bank contact. It also operates to interrupt its own circuit at the springs 221. If the second bank contact is idle, the private magnet deënergizes and the side switch passes to third position in the usual manner. If this contact is busy, the rotary magnet will continue to rotate the shaft and wipers until an idle line is found. The private bank contacts of the last trunk line similar to 219 and 223 are connected together. Should all the trunk lines be busy, the calling subscriber will be given the busy signal in the following manner: As soon as the wiper 63 engages a grounded contact, a circuit is completed which extends from the guarding ground potential at the bank contact through the wiper 63, springs 224 and 225, springs 227 and 226, relay 228 and the side switch wiper 66 (in second position) to battery B. The relay 228, upon energizing, completes a locking circuit for itself which extends from ground G^{21} through the off-normal springs 229 and 230, springs 231 and 225, springs 227 and 226, relay 228 and the side switch wiper 66 (in second position) to battery B. At the moment the relay 228 is energized the circuit of the rotary magnet 65 is opened at the springs 215 and 216, thus preventing the rotary magnet from being operated. The private magnet remains energized and locks the side switch in second position. The locking circuit for said private magnet extends from ground G^{21} through the off-normal springs 229 and 230, springs 231 and 232, left-hand winding of the private magnet 70 and the relay 208 to battery B. The calling subscriber is given the busy signal over the following circuit from the busy signaling machine L through the springs 233, side switch wiper 69 (in second position), condenser 234, over the heavy conductor through the substation A' and over the return heavy conductor back to the busy machine L. Assuming that the trunk lines were not all engaged and that the private wiper 60 found an idle contact, the private magnet 70 deënergizes and allows the side switch to pass from second to third position. By the engagement of the side switch wipers 68 and 69 with their third-position contact points, and by the deënergization of the relay 208, the line connection is completed with the called subscriber, as shown by the heavy conductors. The relay 208 controls contacts in the line circuit and is made slow acting so as to prevent the completion of the line connection until after the cut-off winding 235 of the line switch C' has had time to operate its armature 236 to disconnect the line relay 237 from the line. The circuit of the winding 235 is closed by the engagement of the side switch wiper 67 of the connector J with its third-position contact point, said circuit extending from ground G^{23} through the side switch wiper 67, private wiper 60, bank contact 219, conductor 238 and the winding 235 to battery B. The connection of ground G^{23} with the connector bank contact 219 of the called line prevents the called line from being seized by any other connector switch. By the engagement of the side switch wiper 66 with its third-position contact point, the circuit of the ringer relay 74 is closed. This circuit extends from ground G^{24} through the interrupter 240, relay 74, springs 241 and the side switch wiper 66 (in third position) to battery B. The ringing relay, upon energizing, disconnects the calling line from the called line and bridges the ringing current generator R across the called line to signal the called subscriber. The ringing relay is energized only intermittently through the medium of the interrupter 240. Upon the response of the called subscriber his line is provided with talking current through the back-bridge relay 73, said circuit extending from ground G^{19} through the springs 197, left-hand winding of the relay 73, over the heavy conductor 243, back contact of the ringer relay springs, springs 242, wiper 59, bank contact 2 4, over the heavy trunk line, through the substation A, over the return trunk line, bank contact 245, wiper 61, springs 246 and back contact ringer relay springs, conductor 247 and the right-hand winding of the relay 73 to battery B. The relay 73, upon energizing, closes the circuit of the ringer cut-off relay 248, which circuit extends from ground G^{21} through the springs 229 and 230, springs 249 of the back-bridge relay 73, relay 248 and the side switch wiper 66 (in third position) to battery B. The relay 248, upon energizing, interrupts the circuit of the ringer relay 74 at the springs 241 and closes a locking circuit for itself through the springs 250 independent of the springs 249. A further result of the energization of the back-bridge relay 73 upon the response of the called subscriber is the transposition of the battery connections of the windings of the line relay 72 with regard to battery B, whereby the direction of the current in the calling line is reversed.

If a subscriber whose line switch winding 12 is not shunted by a resistance 203 should attempt to complete a connection with the subscriber A, the marginal relay 62 would fail to be operatively energized. Therefore, as soon as the calling subscriber operates his dial for the third digit 0 of the called number he will receive a busy signal over

the following circuit: From the busy signaling machine L through the springs 252 and 251 of the marginal relay 62, springs 212 and 211, side switch wiper 69 (in second position), condenser 234, over the heavy trunk conductor, through the calling substation and back over the heavy return conductor to the busy signaling machine L. Should the calling subscriber now attempt to call the last digit, the shaft and shaft wipers would fail to rotate, as the rotary magnet circuit is open at the springs 218 and 217 of the marginal relay 62, the springs 214 and 213 being open, as it will be remembered that these springs were opened by the shaft upon reaching the tenth level.

The release of the apparatus is brought about by the hanging up of the receiver at the calling station in the following manner: When the receiver at substation A′ is restored to the switchhook, the separation of the hook-switch springs 120 and 121 destroys the energizing circuit of the connector line relay 72. The relay 72 is thereupon deenergized and opens the circuit of the relay 196. The relay 196, upon deënergizing, opens the holding circuit of the relays 171 and 86 of the selectors F and E, respectively, and the winding 12 of the line switch C, and closes the circuit of the connector release magnet 71. This latter circuit extends from ground G^{18} through the springs 194 and 204, springs 206 and 253, off-normal springs 254 and 255 and the release magnet 71 to battery B. The release magnet, upon energizing, restores the switch shaft and side switch wipers to normal position and also closes a circuit extending from ground G^{25} through the contact 256 to the private bank contact 184 for the purpose of making said contact busy until the switch has returned to normal position. The circuit of said release magnet is broken at the springs 254 and 255 when the shaft reaches its lowest position. The deënergization of the relay 171 of the selector F closes a circuit through the release magnet 258. This circuit extends from ground G^{18} through the springs 175 and 259, springs 260, springs 261 and 261^a, off-normal springs 262 and the release magnet 258 to battery B. The selector F releases, thus breaking its own release circuit when the shaft reaches its lowest position. The selector E releases in the same manner as the selector F. The winding 12 of the line switch C, upon becoming deënergized, allows the plunger arm 9 to return to normal position.

It will now be explained how a subscriber A′ may call a subscriber whose line terminates in a distant main exchange through the medium of a repeater in a third exchange. There is a plurality of trunk lines leading from the third level of the selector E to the repeater I in the second sub-exchange, the trunks from which may lead to a selector or a connector (not shown) in the main exchange.

Since the operation of the line switch C and the selector E have hereinbefore been described, I will now assume that the subscriber A′ has removed his receiver and rotated his dial for the first digit 3, connecting the wipers 25, 26 and 27 of the first selector E with the bank contacts 263, 264 and 265. As soon as the connection is completed with the trunk conductors 266 and 267, the line relay 54 of the repeater I is energized. This circuit extends from ground G^{26} through the lower winding of the relay 54, contact of springs 269 and 270 of the so-called back-bridge relay 56, conductor 271, trunk conductor 267, bank contact 265, wiper 27, over the heavy conductor, through the substation A′, over the heavy return conductor, wiper 25, bank contact 263, trunk conductor 266, conductor 273, springs 274 and 275 and the upper winding of the relay 54 to battery B′. The relay 54, upon energizing, closes a circuit extending from ground G^{27} through the springs 276 and 277 and the relay 57 to battery B′. The relay 57, upon energizing, provides a holding circuit for the relay O. Said circuit extends from ground G^{28} through the right-hand winding of the relay 55, springs 278 and 279, springs 280 and 281, over the conductor 272 and the relay O to the battery lead 100. The relay O, upon energizing, completes a holding circuit for the relay 86 of the selector E and the winding 12 of the switch C. This circuit extends from ground G^{29} through the springs 282 and 283, conductor 268, bank contact 264 and the wiper 26 to the point 112. Here the circuit divides, one branch extending through the springs 94 and 98 and the relay 86 to the battery lead 100, the other branch extending through the off-normal springs 93 and 92, springs 91 and 90, bank contact 21, wiper 17 and the winding 12 to the battery lead 100. The relay O also provides a guarding ground potential extending from ground G^{29} to the private bank contact 264 and thence to the corresponding contact in the bank of each selector which has access to the repeater I from this sub-exchange. The relay 57 also provides a guarding potential extending from ground G^{28} through the right-hand winding of the relay 55, springs 278 and 279 and the springs 280 and 281 to the private bank contact 300, and thence to the corresponding contact in the bank of each selector which has access to the repeater I from the exchange in which said repeater is located. Therefore it will be seen that I have provided a method for making the trunk line to the main exchange busy to all calling subscribers in both sub-exchanges as soon as the same is seized. Another result of the ener-

gization of the relay 57 is the closure of a circuit from ground G^{28} through the right-hand winding of the coil 55, springs 278 and 279, springs 280 and 281 and the left-hand winding of the relay 56 to battery B. The relay 56 is so constructed and adjusted that it cannot be operatively energized by one winding alone, but requires the combined energization of both its windings to cause it to attract its armature. The engagement of the springs 284 and 285, upon the energization of the repeater line relay 54, closes a circuit through the line relay of a connector or selector (not shown) similar to the selector F or the connector J located in the main exchange, said circuit extending from ground through one winding of the line relay, trunk conductor 286, springs 285 and 284, left-hand winding of the impedance coil 55, right-hand winding of the relay 56, trunk conductor 287 and the opposite winding of the line relay to battery. Although both windings of the relay 56 of the repeater now carry current, the relay is not operatively energized, because the current flows through the two windings in opposite directions. The apparatus is now in position for the reception of impulses to complete the connection. The line relay 54 of the repeater I operates in accordance with the impulses of current transmitted from the substation A′ and in turn repeats the impulses over the conductors 286 and 287 to operate the switches in the main office to complete the connection. These impulses are repeated through the medium of springs 284 and 285 of the line relay 54 which open and close a short circuit across the trunk conductors 286 and 287, the relays 55 and 56 being short circuited by the energization of slow acting relay 58. The calling man releases this connection by hanging up his receiver, whereupon the line relay 54 falls back and opens the circuit of the line relay of the switch which it has selected, at the springs 284 and 285 allowing it to release in the usual manner. Relay 54 upon deënergizing also opens the circuit of the slow acting relay 57, which relay in turn falls back and opens the circuit of the back bridge relay 56 and impedance coil 55 at the springs 280 and 281, and removes the guarding potential from the conductor 272. The circuit of the relay O is thereupon broken and this relay upon falling back removes the holding ground from the selector E and line switch C, allowing them to release in the usual manner.

From the foregoing it will be seen that I have provided a telephone exchange system in which a trunk line may extend through a number of exchanges and terminate in a main exchange, and I have also provided means for making said trunk line busy to all exchanges when seized by a subscriber in any one of the said exchanges. To accomplish the above result, relays O are placed in multiple with the third trunk conductor in the various exchanges. Said relays are adapted to energize as soon as the trunk line is seized and operate to place a guarding potential on the bank contact of every selector in the various exchanges that have access to said trunk.

I have also provided and devised a very efficient mechanism for making reverting calls. This is accomplished by allotting a special set of numbers to each subscriber on a party line for use in calling other subscribers on his line. These numbers may be arranged on a card which is placed at each subscriber's phone. For example, if the subscriber at A′ wishes to call the subscriber at A^2 whose directory number is assumed to be #2220 he will first consult the card of special numbers and find what number he is to call in order to connect with the proper combination of generators which will ring the desired bells. He then operates his dial in accordance with this number, and then, upon replacing his receiver upon the hook, his bell is sounded to advise him of the fact that the called subscriber is being signaled. The cessation of this signal advises him of the fact that the called subscriber has answered. It will also be seen that my mechanism controls circuits whereby the called subscribers' bells may be rung a number of times, while the calling subscribers' bells need only to be rung once to notify him that the called subscriber is being signaled.

Furthermore, I have devised a connector switch which is in the nature of a discriminating switch, *i. e.*, it allows certain subscribers to be called by only certain other subscribers.

It will also be seen that the release magnets of the selector E, the selective device H and the connector J are provided with means for providing a guarding ground potential to their corresponding bank contacts until said release magnets have deënergized, which occurs as soon as the switch shaft has returned to normal position.

While I have illustrated and described my invention in connection with a particular type of automatic system in which well-known types of automatic switches are employed, it will be readily understood that various forms of switches can be employed without departing from the spirit of my invention and that various other changes and modifications can be made. Likewise certain features of my invention are adapted for use in semi-automatic systems—that is, in systems where connection is extended in part through the medium of a manual operator's link circuit.

What I claim as my invention is:—

1. In a telephone system, a party-line having a plurality of substations thereon, a

plurality of ringing generators at the central office, one for each substation, and means under the control of a subscriber on said line for connecting any two of said generators with the line to alternately ring the signal at his own station and the signal at one of the other stations, said means including a ring-back apparatus having a single pair of line wipers.

2. In a telephone system, a party-line, a ring-back apparatus associated therewith, said apparatus comprising one set of line wipers and a private wiper, a plurality of ringing generators, and means for connecting a plurality of said generators alternately with said line through said line wipers.

3. In a telephone system, a party-line, a plurality of substations thereon, corresponding series of ringing generators, one corresponding to each substation, a ring-back apparatus including a line wiper, means for connecting any pair of said generators with said line, and means for causing ringing current from said selected generators to pass alternately through said line wiper to said line.

4. In a telephone system, a trunk line, a pair of line terminals and a third conductor associated with each end of said trunk, means for seizing said line terminals, and means for then connecting one pole of battery in a local circuit with the third terminal at the distant end of the trunk, said means including a relay at the distant end and a circuit for said relay controlled from the other end over a circuit separate from the talking circuit.

5. In a telephone system, a trunk line, a private conductor associated therewith, private contacts associated with each end of said trunk, means for seizing one end of said trunk, a relay at the distant end of said trunk adapted to be energized over said trunk, means controlled by the energization of said relay to ground said private conductor, and means controlled by the grounding of said conductor for connecting battery locally with each of the third contacts at the opposite end of said trunk.

6. In a telephone system, a trunk line, means for extending a connection to said trunk, a relay associated at the opposite end of said trunk adapted to be energized when said trunk is seized, and means controlled by the energization of said relay for connecting battery locally with the testing contact associated with each end of said trunk.

7. In a telephone system, a plurality of subscribers' lines, an automatic connector switch having a plurality of groups of line contacts, means for extending a connection from any of said subscribers' lines to said connector, means for permitting all of said subscribers to extend a connection through certain of said groups of contacts, and means for permitting only a portion of said subscribers to extend a connection through other of said groups of contacts.

8. In a telephone system, a plurality of subscribers' lines, an automatic connector switch provided with a plurality of groups of bank contacts, means in said connector for causing the same to automatically select an idle contact in certain of said groups, means for extending a connection from any of said lines to said connector, and means for preventing certain of said subscribers from operating said connector to select an idle trunk in said certain groups.

9. In a telephone system, a plurality of subscribers' lines, a line switch associated with each of said lines, a relay associated with each of said line switches, a resistance in shunt of said relay in certain of said line switches, a connector switch, means for extending a connection through any of said line switches to said connector switch, means for causing one operation of said connector when connection is extended through said line switches which are provided with such shunt, and means for preventing this operation of said connector when connection is made with said connector through a line switch which is not provided with such shunt.

10. In a telephone system, a plurality of subscribers' lines, a line switch associated with each of said lines, a relay for each line switch, certain of said relays being provided with a shunt winding, a connector, means for establishing connection with said connector from any of said lines, means for causing said connector to select an idle trunk in a group when it has been raised to a certain level, and means for preventing such operation of said connector when connection is extended to the same through a line switch which is not provided with a shunt.

11. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector.

12. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means individual to the connector for rendering the connector inoperative after a line has been trunked to the connector, and means individual to the

connector for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector.

13. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means in part individual to the connector and in part to the said other line.

14. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line.

15. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said resistance consisting of the cut-off relay of said individual switch and a coil in multiple therewith.

16. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, an operating magnet circuit for said connector, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said relay having under its control said operating magnet circuit of the connector.

17. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector.

18. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means individual to the connector for rendering the connector inoperative after a line has been trunked to the connector, and means individual to the connector for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector.

19. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector, said last means in part individual to the connector and in part to the said other line.

20. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line.

21. In a telephone system, a group of subscribers' lines, an individual progressively

movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said resistance consisting of the cut-off relay of said individual switch and a coil in multiple therewith.

22. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, an operating magnet circuit for said connector, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, and means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said relay having under its control said operating magnet circuit of the connector.

23. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, and means in said connector for automatically selecting an idle line and for changing the connector from a purely numerical switch in which each step is responsive to an impulse from the line to a rotary connector under the control of said last means.

24. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, means for rendering the connector inoperative after a line has been trunked to the connector, means for preventing said first means from rendering the connector inoperative after another of said first lines has trunked to the connector, and means in said connector for automatically selecting an idle line and for changing the connector from a purely numerical switch in which each step is responsive to an impulse from the line to a rotary connector under the control of said last means.

25. In a telephone system, a party line, a ring-back apparatus for enabling one party to call another on the same line, means for connecting said line with said apparatus, a plurality of sources of ringing current of different characters, and means controlled by said ring-back apparatus for selecting two of said sources to operate the signals at the calling and called sub-stations, and for at the same time selecting a relay for applying one of said sources to the line.

26. In a telephone system, a party-line, a ring-back apparatus for enabling one party to call another on the same line, means for connecting said line with said apparatus, a plurality of sources of ringing current of different characters, and means controlled by said ring-back apparatus for selecting two of said sources to operate the signals at the calling and called substations, and for at the same time selecting a pair of relays each for applying one of said sources to the line.

27. In a telephone system, a party-line, a ring-back apparatus for enabling one party to call another on the same line, means for connecting said line with said apparatus, a plurality of ringing generators for supplying ringing current of different characters, means controlled by the calling subscriber for operating said apparatus to select any two of said generators, and means for then alternately transmitting the current from said two selected generators over said line, said means comprising a relay individual to one of said generators.

28. In a telephone system, a party-line, a plurality of ringing generators for supplying ringing current of different characters, a step-by-step apparatus for selecting any two of said generators, and means for alternately supplying current from said selected generators to said line, said means comprising a relay individual to said generators.

29. In a telephone system, a party-line, a plurality of ringing generators for supplying ringing current of different characters, a step-by-step ring-back apparatus, means for connecting said line with said apparatus, means controlled by the calling subscriber for operating said ring-back apparatus to select any two of said ringing generators, and means for then alternately con-

necting said selected ringing generators with the line, said means comprising a relay individual to one of said generators.

30. In a telephone system, a party-line, a ring-back apparatus comprising a plurality of generators for enabling one party to call another on the same line, and means controlled by said ring-back apparatus for transmitting two kinds of ringing current back over said line to operate the calling signal at both the calling and called substations on said line, said means comprising a relay individual to one of said generators, said ring back operated by current over the line for the purpose set forth.

31. In a telephone system, a party-line, a ring-back apparatus for enabling one party to call another on the same line, means for connecting said line with said apparatus, a plurality of ringing generators for supplying ringing current of different characters, means controlled by the calling subscriber for operating said apparatus to select any two of said generators, and means for then alternately transmitting the current from said two selected generators over said line, said means comprising a relay individual to each one of said generators.

32. In a telephone system, a party-line, a plurality of ringing generators for supplying ringing current of different characters, a step-by-step apparatus for selecting any two of said generators, and means for alternately supplying current from said selected generators to said line, said means comprising a relay individual to each one of said generators.

33. In a telephone system, a party-line, a plurality of ringing generators for supplying ringing current of different characters, a step-by-step ring-back apparatus, means for connecting said line with said apparatus, means controlled by the calling subscriber for operating said ring-back apparatus to select any two of said ringing generators, and means for then alternately connecting said selected ringing generators with the line, said means comprising a relay individual to each one of said generators.

34. In a telephone system, a party-line, a ring-back apparatus comprising a plurality of generators for enabling one party to call another on the same line, and means controlled by said ring-back apparatus for transmitting two kinds of ringing current back over said line to operate the calling signal at both the calling and called substations on said line, said means comprising a relay individual to each one of said generators, said ring back operated by current over the line for the purpose set forth.

35. In a telephone system, a party-line, a ring-back apparatus for enabling one party to call another on the same line, a plurality of ringing current generators, said ring-back apparatus comprising a pair of wipers, and means for connecting said wipers to the line and for thereafter alternately connecting said generators with said wipers.

36. In a telephone system, a party-line, a ring-back apparatus for enabling one party to call another on the same line, means including a selector switch for extending a connection from said line to said ring-back apparatus, a plurality of sources of ringing current, means controlled by said ring-back apparatus for selecting any two of said sources, and means controlled by the replacing of the calling subscriber's receiver upon the switch-hook for alternately transmitting current from said two selected generators over said line, said means comprising a relay individual to one of said generators.

37. In a telephone system, a party line, a ring-back apparatus for enabling one party to call another on the same line, means including a selector switch for extending a connection from said line to said ring-back apparatus, a plurality of sources of ringing current, means controlled by said ring-back apparatus for selecting any two of said sources, and means controlled by the replacing of the calling subscriber's receiver upon the switch-hook for alternately transmitting current from said two selected generators over said line, said means comprising a relay individual to each one of said generators.

38. In a telephone system, a line, a second line, means for connecting said first and second lines, a plurality of signals operatively associated with said first line, an automatic switch for said second line, a signaling circuit for each signal under the control of said switch, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and an impulse sender for operating said automatic switch over said second line, to apply signaling current to said first line, for operating both said signals while the first and second lines are connected, said relay controlling the application of signaling current from said generator.

39. In a telephone system, a line, a second line, means for connecting said first and second lines, a plurality of signals operatively associated with said first line, an automatic switch for said second line, a signaling circuit for each signal under the control of said switch, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to each generator, and an impulse sender for operating said automatic switch over said second line to apply signal-

ing current to said first line, for operating both said signals while the first and second lines are connected, said relays controlling the application of the signaling current to the line.

40. In a telephone system, a line, a second line, a pair of signals for said first line, means for connecting the lines, a signaling circuit for each signal, means for supplying signaling current to said signaling circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for associating said signaling circuits with the connected line circuit while the two lines are connected, said relay controlling the application of signaling current from said generator.

41. In a telephone system, a line, a second line, a pair of signals for said first line, means for connecting the lines, a signaling circuit for each signal, means for supplying signaling current to said signaling circuits comprising a generator for each circuit and a relay individual to each generator, and automatic means for associating said signaling circuits with the connected line circuit while the two lines are connected, said relays controlling the application of the signaling current to the line.

42. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for selecting any two of said circuits and for associating the selected signaling circuits with the connected line circuit while the said two line circuits are connected, said relay controlling the application of signaling current from said generator.

43. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to each generator, and automatic means for selecting any two of said circuits and for associating the selected signaling circuits with the connected line circuit while the said two line circuits are connected, said relays controlling the application of the signaling current to the line.

44. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for selecting a plurality of said generators and for associating the selected generators with the said first line while the said lines are connected, said relay controlling the application of signaling current from one of said generators to the said first line.

45. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to each generator, and automatic means for selecting any two of said circuits and for associating the selected signaling circuits with the connected line circuit while the said two line circuits are connected, said relays controlling the application of the signaling current to the line.

46. In a telephone system, a line, a second line, automatic means for connecting said first and second lines, a plurality of signals operatively associated with said first line, an automatic switch for said second line, a signaling circuit for each signal under the control of said switch, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, an impulse sender for operating said automatic switch over said second line, to apply signaling current to said first line, for operating both said signals while the first and second lines are connected, said relay controlling the application of signaling current from said generator, said impulse sender also for controlling said automatic means over the second circuit for the purpose set forth.

47. In a telephone system, a line, a second line, automatic means for connecting said first and second lines, a plurality of signals operatively associated with said first line, an automatic switch for said second line, a signaling circuit for each signal under the control of said switch, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to each generator, and an impulse sender for operating said automatic switch over said second line to apply signaling current to said first line, for operating both said signals while the first and second lines are connected, said relays controlling the application of the signaling current to the line, said impulse sender also for controlling said automatic means over the second circuit for the purpose set forth.

48. In a telephone system, a line, a second line, a pair of signals for said first line, means for connecting the lines, a signaling circuit for each signal, means for supplying signaling current to said signaling circuits comprising a generator for each circuit and a relay individual to one of said generators, and

automatic means for associating said signaling circuits with the connected circuit while the two lines are connected, said relay controlling the application of signaling current from said generator, and an impulse sender for controlling said automatic means over the second circuit for the purpose set forth.

49. In a telephone system, a line, a second line, a pair of signals for said first line, means for connecting the lines, a signaling circuit for each signal, means for supplying signaling current to said signaling circuits comprising a generator for each circuit and a relay individual to each generator, and automatic means for associating said signaling circuits with the connected circuit while the two lines are connected, said relays controlling the application of the signaling current to the line, and an impulse sender for controlling said automatic means over the second circuit for the purpose set forth.

50. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for selecting any two of said circuits and for associating the selected signaling circuits with the connected circuit while the said two line circuits are connected, said relay controlling the application of signaling current from said generator, and an impulse sender for controlling said automatic means over the second circuit for the purpose set forth.

51. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for selecting a plurality of said generators and for associating the selected generators with the said first line while the said lines are connected, said relay controlling the application of signaling current from one of said generators to the said first line, said automatic means operated over the connected lines.

52. In a telephone system, a line, a second line, a plurality of signals for said first line, means for connecting the two lines, a signaling circuit for each signal, means for supplying signaling current to said circuits comprising a generator for each circuit and a relay individual to one of said generators, and automatic means for selecting a plurality of said generators simultaneously and for associating the selected generators with the said first line while the said lines are connected, said relay controlling the application of signaling current from one of said generators to the said first line, said automatic means operated over the connected lines.

53. In a telephone system, a plurality of subscribers' lines, a line switch associated with each of said lines, a relay associated with each of said line switches, a resistance in shunt of said relay in certain of said line switches, a connector switch, means for extending a connection through any of said line switches to said connector switch, electromagnetic means for causing one operation of said connector when connection is extended through said line switches which are provided with such shunt, and a connector controlled switch for preventing this operation of said connector when connection is made with said connector through a line switch which is not provided with such shunt.

54. In a telephone system, a plurality of subscribers' lines, a line switch associated with each of said lines, a relay for each line switch, certain of said relays being provided with a shunt winding, a connector, means for establishing connection with said connector from any of said lines, means for causing said connector to select an idle trunk in a group when it has been raised to a certain level, and a connector controlled switch for preventing such operation of said connector when connection is extended to the same through a line switch which is not provided with a shunt.

55. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector.

56. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch individual to the connector for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means individual to the connector for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector.

57. In a telephone system, a group of subscribers' lines, an individual progressively

movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means in part individual to the connector and in part to the said other line.

58. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line.

59. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said last means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said resistance consisting of the cut-off relay of said individual switch and a coil in multiple therewith.

60. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, an operating magnet circuit for said connector, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, said means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said relay having under its control said operating magnet circuit of the connector.

61. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing said connector controlled switch from rendering the connector inoperative after another of said first lines has trunked to the connector.

62. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch individual to the connector for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means individual to the connector for preventing said connector controlled switch from rendering the connector inoperative after another of said first lines has trunked to the connector.

63. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing said connector controlled switch from rendering the connector inoperative after another of said first lines has trunked to the connector, said means in part individual to the connector and in part to the said other line.

64. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing said connector controlled switch from rendering the con-

nector inoperative after another of said first lines has trunked to the connector, said means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line.

65. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, electromagnetic means for preventing said connector controlled switch from rendering the connector inoperative after another of said first lines has trunked to the connector, said means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said resistance consisting of the cut-off relay of said individual switch and a coil in multiple therewith.

66. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, an operating magnet circuit for said connector, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, and electromagnetic means for preventing said connector controlled switch from rendering the connector inoperative after another of said first lines has trunked to the connector, said means comprising a relay individual to the connector and a circuit for said relay through a resistance in the individual switch allotted to the said other line, said relay having under its control said operating magnet circuit of the connector.

67. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after a line has been trunked to the connector, electromagnetic means for preventing the connector from being rendered inoperative after another of said first lines has trunked to the connector, and means in said connector for automatically selecting an idle line and for changing the connector from a purely numerical switch in which each step is responsive to an impulse from the line to a rotary connector under the control of said last means.

68. In a telephone system, a group of subscribers' lines, an individual progressively movable trunking switch for each line, a second group of lines, a connector for extending a connection to said lines of the second group, said connector accessible in common to said individual switches, a connector controlled switch for rendering the connector inoperative after another of said first lines has trunked to the connector, and means in said connector for automatically selecting an idle line and for changing the connector from a purely numerical switch in which each step is responsive to an impulse from the line to a rotary connector under the control of said last means.

Signed by me at Chicago, Cook county, Illinois, the 16th day of February, 1914.

TALBOT G. MARTIN.

Witnesses:
HARRY E. HERSHEY,
C. W. BUELL.